R5620-1.15F(A)
1/89

RESEARCH REPORT 70

AGRICULTURE IN THE GATT: AN ANALYSIS OF ALTERNATIVE APPROACHES TO REFORM

Joachim Zietz
Alberto Valdés

November 1988

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Research Report 70
International Food Policy Research Institute
in collaboration with the
Kiel Institute of World Economics
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Library of Congress Cataloging
in Publication Data

Zietz, Joachim, 1953-
Agriculture in the GATT.

(Research report / International Food Policy Research Institute in collaboration with the Kiel Institute of World Economics)
"November 1988."
Bibliography: p. 114.
1. Produce trade — Government policy. 2. Tariff on farm produce. 3. Agriculture and state. 4. General Agreement on Tariffs and Trade (Organization)
I. Valdés, Alberto, 1935- . II. Title. III. Series: Research report (International Food Policy Research Institute) ; 70.

HD9000.6.Z53 1988 382'.41 88-34711
ISBN 0-89629-072-7

CONTENTS

Foreword

1. Summary 7

2. Introduction 10

3. Agriculture in the GATT: An Overview 12

4. Criteria for Evaluating Trade Reform Proposals 25

5. The Theoretical Consequences of Changing Certain GATT Provisions 39

6. Outline of a Trade Reform Package 69

Appendix 1: Selected Articles of the General Agreement 80

Appendix 2: Selected Articles of the Subsidies Code 102

Appendix 3: Ministerial Declaration on the Uruguay Round 109

Bibliography 114

TABLES

1. Average applied tariffs for 11 developed market economies, by product group, 1983 14
2. Post-Tokyo Round applied tariffs for raw and processed products of selected developed countries 14
3. Percentage of seven industrial countries' imports subject to nontariff barriers, by product group, 1983 15
4. Percentage of seven industrial countries' imports of agricultural products subject to nontariff barriers, by type of measure, 1983 15
5. Financing of agricultural policy by seven industrial countries, 1979-81 average 16
6. Gross expenditures by the EC for price support and income transfers, 1974-87 18
7. Net expenditures by the United States for price support and income transfers, 1974-87 19
8. Price and trade effects of agricultural protection, by various products and countries, 1980-82 20

ILLUSTRATIONS

1. Predicted impact of trade reform on trade volume in n years with everything else assumed constant 33
2. Predicted change in observable trade volume over n years, with trade reform as well as demand and supply growth 34
3. Pure supply-side policy 45
4. Partial replacement of import protection with domestic subsidies 47
5. Two-price system 48
6. Two-price system with implicit export subsidization 49
7. Producer-financed export subsidies 52
8. Minimum-access guarantees under alternative economic conditions 56
9. Tariffs and global quotas with domestic production growth 61
10. Trade impact of domestic subsidies at different levels of world price 64

FOREWORD

The Uruguay Round of multilateral trade negotiations under the aegis of the GATT provides a unique opportunity to move toward resolution of the crisis that has characterized international trade in agricultural products for some time. The outcome of the Uruguay Round may well set the framework for trade relations for years to come. The stakes in the negotiations are high, not only for industrialized countries, but in particular for developing countries. Security and predictability of market access, and stability of trade relations and international agricultural markets are of great importance to the economic growth of the food and agricultural sectors of developing countries as well as their overall economy.

The International Food Policy Research Institute has published several other studies on similar trade-related topics. These include an analysis of the international effect of Soviet grain imports and of European grain policies, the political-economy determinants of U.S. and European agricultural and trade policies, and an earlier quantitative study by Valdés and Zietz of the costs to developing countries of protectionist policies in OECD countries.

In a sense, the current study is a sequel to the authors' previous research report. Having established earlier the high costs of trade protectionism that characterize the current crisis in agricultural trade, they now offer a comprehensive conceptual analysis of the main ideas for trade reform in agriculture. As the Uruguay Round is now going into its second and decisive half, this report is particularly timely. Its careful analysis of numerous trade reform ideas using a common reference system offers the reader a much-needed orientation as well as a new perspective on the problems surrounding trade reform.

IFPRI is grateful to the Kiel Institute of World Economics and to its president, Herbert Giersch, for their generous support of this undertaking. We hope that this joint effort will advance the goals of the Uruguay Round and thus contribute to a better trading environment in agriculture.

John W. Mellor

Washington, D.C.
November 1988

ACKNOWLEDGMENTS

The authors would like to thank the Kiel Institute of World Economics under its president, Herbert Giersch, in Kiel, West Germany, for support of their work during the early part of the study's preparation. Many thanks are owed to Ammar Siamwalla, Joachim von Braun, other colleagues at IFPRI, and several anonymous reviewers for their comments and suggestions on an earlier version of the report. Any remaining errors and omissions remain solely the responsibility of the authors.

1

SUMMARY

Much trade in agricultural products is conducted under conditions that bear little resemblance to the letter or the spirit of the General Agreement on Tariffs and Trade (GATT). Nontariff barriers proliferate, export subsidies increasingly substitute for a natural competitive advantage, trade wars erupt with frightening regularity.

There is some hope that the Uruguay Round can achieve more for agricultural trade than prior GATT rounds. Sharply rising budgetary costs of national farm policies in recent years seem to have made the European Community (EC), the United States, and other industrial countries more open to the idea of agricultural trade reform than ever before. There is a danger, however, that diminishing budgetary pressures, which are the result of recently rising world prices and certain adjustments in domestic farm policies, could reduce the current momentum for reform. Piecemeal accommodation on a commodity-by-commodity basis could then be the outcome of the Uruguay Round. Although this might suffice to further stabilize government budgets, it would not bring lasting improvement. It is therefore important not to lose sight of the final objective of trade reform in agriculture: to establish an environment that is free of trade-distorting government interventions, fully integrated into the GATT, yet flexible enough to deal with domestic structural adjustment problems and income instability.

Not every reform proposal that is under current discussion is likely to ease the transition to this state of world trade. Some may make it actually impossible to ever get there. It is important, therefore, to analyze the properties of a given reform proposal before much time is spent on it during the trade negotiations. For that purpose, a number of criteria are developed to check (1) to what extent a given reform proposal is consistent with the final objective of trade reform, (2) whether the proposal has any practical value in day-to-day operations, and (3) whether it has the potential to win the approval of the main players in the Uruguay Round—the United States, the EC, the nonsubsidizing exporters united in the Cairns Group, and Japan.

When these criteria are confronted with actually proposed ideas for trade reform, it becomes clear that there is no single idea or element of trade reform that would satisfy all the criteria that are established. Yet there is some evidence that an appropriate combination of reform ideas might achieve this goal. One such combination would consist of two elements: a strict ban on export subsidies, and comprehensive tariffication.

The ban on export subsidies would eliminate the special treatment for agricultural, fishery, and forestry products in the General Agreement and the Subsidies Code. Tariffication consists of two components: the replacement of all unbound tariffs and nontariff barriers with bound base tariffs that are uniform across broad commodity groups for each country, and the extension of that change to the safeguard Article XIX of the General Agreement.

The bound base tariff represents the basic tariff concession of a country. It is the tariff level that a given country would apply uniformly across broad commodity groups, once the adjustment to a system based only on tariffs is completed. A country is bound to this tariff at all times unless it invokes Article XIX. Extending tariffication to Article XIX implies that safeguard measures are limited to temporary tariff increases. A revised safeguard Article XIX is envisioned to operate as follows. A country using a temporary tariff increase, or excess tariff for short, would bind itself to a timetable for lifting the safeguard measure. This timetable would specify the dates on which the excess tariff would be reduced to zero as well as the step size of the individual reductions. To avoid prohibitive tariffs the use of excess tariffs under the safeguard article could be conditioned on some minimum-access provision similar in spirit to that currently written into Article XI:2(c). Article XI:2 could be rewritten so as to apply to all trade regardless of sector and whenever a country uses any import restriction other than its bound base tariffs.

The excess-tariff provision is envisioned as the major vehicle to eventually reach a system based only on bound, uniform tariffs. Excess tariffs would offer temporary import relief for all products that are currently protected by nontariff barriers with tariff equivalents far in excess of the uniform base tariff that a given country would adopt after the adjustment to the new system.

As excess tariffs are lowered over time, according to some fixed schedule, to the level of the bound base tariff, and as the resultant adjustment pressure grows, countries may resort to gray-area measures to reduce this pressure. Four types of gray-area measures to avoid the disciplines of tariffication are of particular interest in this context: voluntary export restraints, state trading arrangements, domestic subsidies, and exchange-rate manipulations.

The potential problem of voluntary export restraints could be contained by prohibiting them explicitly and, at the same time, giving the GATT Secretariat an active role in supervising this prohibition, including the right to initiate cases against a country that forces export-restraint agreements on its trading partners. Treating export subsidies in agriculture the same as in other sectors should go a long way toward eliminating implicit export subsidies by state trading enterprises in agriculture. Implicit quantitative import restrictions, in contrast, are more difficult to prevent. The only practical solution may be to restrict their operations on the import side indirectly through binding the nominal rate of protection for all those goods under their control. In particular, it could be stipulated that the price difference between the border price and the domestic wholesale price of products under the control of state trading enterprises should not exceed the equivalent of the bound base tariffs for those products.

As long as it is believed that domestic subsidies will not be a major issue under a system of relatively low uniform tariffs, it may be most efficient to resolve domestic subsidies issues on a case-by-case basis. This could be achieved either through negotiations outside the GATT or through dispute settlement inside the GATT. The latter would require, however, that the current dispute-settlement procedure be made more responsive. This is in the special interest of developing countries because they generally lack the necessary political or economic clout to settle subsidy issues (or other issues, for that matter) through direct negotiations outside the GATT. Attempts of governments to circumvent the disciplines of tariffication and an export subsidy ban through exchange-rate manipulations may be handled in the same way as domestic subsidies, that is, without adding new provisions to the General Agreement or to its subsidiary codes law.

Compared with alternative suggestions for trade reform (for example, fixing overall protection levels), the above package has a number of advantages. At its core, the reform proposal is not dependent on new policy instruments or measurement techniques that have not been tested. Rather, it relies on well-known GATT instruments and principles. Everything else being constant, this should ease rather than complicate the transition from the current state of trade in agriculture and other industries to the final objective of free trade. Trying to incorporate a completely new, untried approach such as the Producer Subsidy Equivalent into the GATT framework could not only cause the negotiations to deadlock over measurement concepts and problems, but would also have the negative side effect of firmly establishing a "special case" for agriculture rather than integrating this sector fully into the GATT system.

Whether a proposal such as tariffication has a realistic chance of being adopted during the Uruguay Round depends ultimately on its ability to garner enough domestic political support in the major trading nations. Domestic acceptability hinges on a favorable political constellation. It is particularly important that the political power of the groups that stand to lose from a trade-reform proposal in the short run be kept in check by a sufficient amount of countervailing power. This means there have to be other special interest groups, apart from consumers, that are strongly in favor of a trade reform and, at the same time, have enough political influence to counter the efforts of those groups that oppose the reform.

Sector-specific, commodity-based reform proposals that lead to piecemeal trade arrangements for one commodity at a time do not generate the necessary countervailing power. Instead they maximize the influence of special interest groups on the negotiations at the expense of the interests of the whole country. The aggregate negotiating approach advocated by the United States in its reform proposal for agriculture fares somewhat better in generating countervailing power. It suggests that an agreement on all agricultural support programs be concluded in a single package. In this way the political influence of a commodity group that is losing can be counteracted by the influence of a commodity group that stands to gain. This negotiating approach runs into a problem, however, if there are countries with few or no commodity groups that expect to gain from a given reform package. Japan, some northern European countries, and, to some extent, the EC are likely to fall into this category.

The obvious solution is to negotiate in one package not only all of agriculture but all sectors, so that gains anticipated in industry can help to compensate for losses in agriculture or vice versa. Countervailing power would be established across sectors and industries. But just as a package deal in agriculture alone requires a unifying negotiation and measurement concept, so will negotiations across sectors necessitate a unifying principle. Tariffication as defined above could be this sought-after unifying theme or principle. It is applicable for all sectors and is fully compatible with the spirit of the GATT. It could replace the "across-the-board" tariff-reduction idea of the Kennedy and Tokyo rounds.

2

INTRODUCTION

Previous rounds of multilateral trade negotiations under the aegis of the General Agreement on Tariffs and Trade (GATT) have brought little substantive change to agricultural trade. Some observers even go as far as calling agriculture the GATT's greatest failure (Leddy and Reinstein 1987, 45). This conclusion is understandable in view of the crisis that has unfolded in agricultural trade over the past few decades. Its signs are all too familiar; for example, competition by export subsidies rather than comparative advantage, trade disputes over domestic subsidies, rising costs of farm support but falling incomes of farmers, and increasing uncertainty of market access for developing countries.

The Uruguay Round has set out to change this. In contrast to prior trade negotiations, agriculture now occupies center stage. In addition, the negotiations on agriculture have been better prepared than ever before. A Committee on Trade in Agriculture was set up within the GATT in 1982, four years before the beginning of the Uruguay Round, to identify promising reform proposals. Also in 1982, a ministerial meeting of the Organisation for Economic Co-operation and Development (OECD) commissioned a comprehensive study of national agricultural policies and their trade implications. Completed in 1987 (Organisation for Economic Cooperation and Development 1987), the study's intent is to provide a common denominator for the Uruguay Round negotiations among the industrialized countries. Finally, because of the rapidly rising budgetary costs of national farm policies, the European Community (EC), the United States, and other industrialized countries now seem more receptive to the idea of agricultural trade reform.

Commodity prices appear to be rising again after a long period of depression. At the same time, the United States and the EC have made a number of adjustments in their farm support programs to cut budgetary outlays on agriculture. Both events could bring some relief to agricultural commodity markets. However, they could also reduce the incentive to embark on a thorough reform of agricultural trade. Although accommodation on a commodity-by-commodity basis might further stabilize government budgets, it is unlikely to result in lasting improvement. It is therefore important to keep in mind the final objective of agricultural trade reform in the Uruguay Round: an environment without government interventions that distort trade, fully integrated into the GATT, yet with the flexibility to deal with domestic problems of structural adjustment and income instability.

With the Uruguay Round almost two years under way, it has become obvious that progress on agricultural trade is a far more complex problem than negotiating tariff reductions in manufactures. This is because, in most countries, government intervention in agriculture is much more pronounced than in any other industry or sector. The objective of these domestic interventions is to support and stabilize the income of farmers relative to nonfarmers. Many countries consider this to be an issue for domestic policy only. However, many domestic interventions are intimately tied to border measures with a strong trade-distorting effect. This linkage has serious consequences: without a willingness on the part of protecting countries to change the way they manage their domestic income-support programs for farmers, it is difficult if not impossible for them to negotiate on border measures, which happen to be the traditional focal point of multilateral trade negotiations under the aegis of the GATT.

The United States, the EC, the nonsubsidizing exporters united in the Cairns Group, and Japan are the main players of the Uruguay Round. The early part of the current round appears to confirm the practice of the years leading up to this round: the main dividing line for agricultural policy and trade reform is located between the United States and the EC. Most major disputes in the field of agriculture have taken place between these two participants. The sheer size of their economies and their importance for agricultural trade implies that little progress will be possible without resolving their differences. The importance of these two players is reflected in this study, in that much of the analysis is spent on developing their likely responses to alternative reforms of agricultural trade and hence the structure of their domestic support programs.

In contrast, issues specific to developing countries, such as the question of reciprocity, trade preferences, and tropical products, are neither examined as separate topics nor do they occupy center stage.[1] But although the study does not revolve around these issues, this does not make it irrelevant to less developed countries (LDCs). On the contrary, concentrating on the broader aspects of agricultural trade reform makes it easier to reflect more sharply on the value to developing countries of such things as trade preferences, market access, and reciprocity than if they were discussed in isolation.

There is a final caveat the reader should keep in mind. It is not intended to present and discuss in detail all the various trade reform proposals either suggested in the literature, discussed by the Committee on Trade in Agriculture, or already tabled in the negotiating group on agriculture at the Uruguay Round meetings in Geneva. This would probably be a poor approach because of the sheer number of proposals, their sometimes imprecise statement, and their character as bargaining instruments. The preferred alternative is to break down the proposals into their main generic elements or ideas and to examine these. Examples of such elements that make up comprehensive trade reform proposals are further disciplining or banning export subsidies, providing exporters with minimum access to import markets, converting nontariff barriers into tariffs, and binding the overall protection level.

The analysis concentrates on the economic aspects of agricultural policy and trade reform. However, where appropriate, relevant political-economy considerations and implications are taken up. The analysis is conducted at a level that makes it comprehensible to the nontechnically inclined. Most of the analysis relies on verbal reasoning. Graphs are added where they help illustrate some more involved points.

The following chapter gives a brief overview of the current state of agricultural trade. It touches on the legal environment of the General Agreement, the extent and economic consequences of protectionism in agricultural trade, and the current status of the Uruguay Round negotiations. The subsequent chapter establishes the criteria to be used for discriminating among various ideas for trade reform. Next, these criteria are confronted with the major reform ideas under current discussion. The last chapter draws the conclusions from the prior analysis by combining a number of reform ideas into a trade reform package that both lives up to the criteria established earlier and is reasonably realistic.

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[1] Interested readers are referred to the specialized literature: Hudec 1987; Finger and Olechowski 1987; and Valdés 1987. These studies contain a large number of further references that deal specifically with the problems of developing countries.

3

AGRICULTURE IN THE GATT: AN OVERVIEW

The Legal Background

Although the rules and regulations of the General Agreement apply in general to agriculture as they do to manufacturing, there are several significant exceptions. They relate mainly to the treatment of quantitative trade restrictions and export subsidies. (Of the GATT's 38 articles, only 4 contain special provisions for agriculture. These are Articles VI, XI, XVI, and XX. See Appendix 1 for a reprint of these and other articles referenced in this report.)

Articles XI to XIV and Article XIX of the General Agreement specify the rules for quantitative import restrictions. Of these, Article XIX provides a justification for quantitative import restrictions on all goods, not just primary goods, if surging imports are thought to harm domestic producers. Article XI is of particular interest to agricultural trade. Its importance derives from its exemption of primary goods, under certain circumstances, from the general prohibition of quantitative import or export restrictions established in the General Agreement. (Since the Tokyo Round, the primary goods category has included agricultural, fishery, and forestry products; before the Tokyo Round, it also included mineral products.) The circumstances justifying quantitative trade restrictions for agricultural goods are the prevention of or relief from shortages of food or other essential products; the enforcement of domestic marketing or production control programs, or the removal of temporary domestic surpluses; and the application of standards of commodity classification, grading, or marketing.

These special exemptions for agricultural and fishery products were incorporated into the original General Agreement in 1947 at the insistence of the United States. In their absence, several U.S. farm support programs that were in effect at that time would have had to be given up. The U.S. Congress, however, was unwilling to trade domestic farm support legislation in favor of a General Agreement without special rules for agriculture. Article XI was weakened even further in its relevance for agriculture in 1955, when the United States asked for and received a permanent exemption from the provisions of Article XI.[2] Since 1955 this exemption has been used at various times by the United States to justify quantitative import restrictions for dairy products, sugar, and beef. Even though the U.S. waiver may not have been important quantitatively, it has been of significance in a qualitative sense. By taking the bite out of Article XI for agriculture, it is likely to have contributed to a more lenient international trading environment. In this way the waiver has advanced the propagation of quantitative import restrictions, state trading, and gray-area measures such as voluntary export restraints.

Regarding subsidies, the GATT has undergone a number of changes since its creation. The treaty's initial version called upon countries applying subsidies only to give adequate notice to all affected GATT signatories. There were no provisions for outlawing subsidies altogether, regardless of whether they were intended to promote exports or address domestic policy objectives. This changed with the 1955 revision of the treaty, when three paragraphs (now XVI:2

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[2] The U.S. request was the result of a congressional amendment of section 22 of the Agricultural Adjustment Act of 1933, which was passed after the GATT had found the United States to be in violation of Article XI for dairy products in 1951. The amendment of section 22 required the administration either to use import quotas to lower imports up to one-half the level of previous period imports or to impose excess ad valorem tariffs of up to 50 percent whenever domestic farm support programs were endangered.

to XVI:4) were added to the original subsidy article, thereby transforming its character.

The most important innovation of the 1955 revision of the General Agreement was the ban on export subsidies. Primary goods, however, were exempted from this general prohibition. Instead, a statement was included to the effect that export subsidies for primary goods should be avoided and that, if applied, they should not result in a more than equitable share of world trade.

The exemption of agriculture, along with fishery and forestry products, from the general ban on export subsidies can again be traced to the influence of the U.S. farm lobby. When the 1955 revisions of the export subsidy Article XVI were reviewed by GATT in 1958, the United States took the lead in defense of that article (Paarlberg 1987, 46). The U.S. position on the export subsidy issue changed only when it became clear in the 1960s, after the establishment of the EC's Common Agricultural Policy in 1962, that the provisions would be used to the detriment of the U.S. agricultural sector. However, no progress was made on the subsidy question either in the Dillon Round (1961-62) or the Kennedy Round (1963-67). In fact, both of those rounds achieved little for agriculture except some statutory tariff reductions.[3]

During the Tokyo Round of multilateral trade negotiations (1973-78) the United States championed, with some success, an effort to further restrain the spreading use of trade-related subsidies. A Subsidies Code was added to the General Agreement.[4] (Articles 8 through 13 of the Subsidies Code, as well as its Annex with an illustrative list of export subsidies, are reprinted in Appendix 2 of this report.) Strictly supplementary to the General Agreement, and binding only to its signatories, the Subsidies Code widened the definition of "more than equitable share" of the world market to cover the displacement of exporters in third-country markets. In addition, some other provisions of Article XVI were somewhat sharpened, and a dispute-settlement mechanism was put in place to enable signatories to enforce their rights under the Subsidies Code. (See Articles 12 and 13 of the Subsidies Code. A thorough discussion of the dispute mechanism can be found in Hudec 1978.)

Only about a quarter of the GATT members have signed the Subsidies Code. It appears that this code is among the least effective of those negotiated during the Tokyo Round. A lack of consensus on the wording and interpretation of the negotiated agreements has given rise to numerous disputes among the signatories. Although the Subsidies Code relates to all trade, most of the disputes have occurred in agriculture. This problem is discussed in more detail in Chapter 5.

The Practice of Agricultural Trade

The legal exemptions granted to agriculture in Articles XI and XVI of the General Agreement have contributed to making agriculture one of the most contentious areas of international trade. Agricultural trade seems to have become increasingly separated from the letter and, in particular, the spirit of the General Agreement. When compared with other sectors or industries, agriculture stands out in at least the following respects: on average, tariff protection is higher than in most other sectors (Table 1), with many tariffs still unbound and at levels that discourage trade; tariff escalation is commonplace and serious (Table 2); the number of nontariff barriers is high compared with the manufacturing average (Table 3); and export subsidies are used on a large scale, distorting trade flows and sparking frequent trade disputes.

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[3] During the Dillon Round, the United States managed to secure a "zero-duty binding" for oilseeds, oilseed meals, and some other feed substitutes from the EC. Although not considered of major importance at that time, this concession has proven to be one of the most significant ever achieved by the United States.

[4] The addition of codes to the General Agreement during the Tokyo Round is discussed in Stern and Hoekman 1987, 59-66.

Table 1—Average applied tariffs for 11 developed market economies, by product group, 1983

Product Group	Tariff Application All Imports	 Imports from Less-Developed Countries
	(percent)	
Food	5.3	5.5
Agricultural materials	0.5	0.5
Fuels	0.6	0.6
Chemicals	3.1	3.7
Other manufactures	4.7	6.7
All items	3.0	2.7

Source: Based on data from Samuel Laird and J. Michael Finger, "Protection in Developed and Developing Countries: An Overview," paper presented at the World Bank-Thailand Development Research Institute Conference, Bangkok, October 1986 (mimeographed), p. 7.

Table 3 reveals that nontariff barriers are more prevalent in agriculture than in manufacturing for most referenced countries. The extent of nontariff protection in agriculture is similar to that of the most highly protected industries within manufacturing—textiles and clothing as well as iron and steel. Table 4 provides a breakdown of nontariff protection in agriculture by type of measure. Both Tables 3 and 4 omit a number of potentially important trade restrictions. Among those nontariff barriers excluded are domestic policy measures such as subsidies to import-competing sectors, government procurement, and restrictions on the domestic sale of foreign goods; generalized procedures applying to all imports; restrictive business practices;

Table 2—Post-Tokyo Round applied tariffs for raw and processed products of selected developed countries

Product	Austria	EC	Japan	Norway	Switzerland	United States
				(percent)		
Meat						
Fresh and frozen	0.2	6.6	10.1	8.3	4.2	1.6
Processed	2.6	17.9	22.5	8.1	5.2	2.3
Vegetables						
Fresh	2.1	6.7	9.0	3.4	4.9	7.6
Processed	13.3	15.1	17.5	6.6	11.4	11.0
Fruit						
Fresh	3.1	7.7	21.5	1.0	7.4	1.1
Processed	17.3	16.6	21.8	3.1	13.7	20.3
Vegetable oils						
Oilseeds	0.5	0.0	0.3	0.0	0.1	1.0
Oils	1.1	6.1	6.2	4.5	8.2	0.7
Sugar						
Raw	0.0	0.0	3.3	3.6	42.3	0.6
Refined	0.0	0.0	82.5	2.7	34.1	9.9
Tobacco						
Raw	9.7	0.0	0.0	0.0	0.0	8.8
Processed	211.3	61.8	82.1	5.1	17.6	9.1

Source: Based on data from Alexander Yeats, "The Escalation of Trade Barriers," in *The Uruguay Round: A Handbook on the Multilateral Trade Negotiations,* ed. J. Michael Finger and Andrzej Olechowski (Washington, D.C.: World Bank, 1987), p. 114.

Table 3—Percentage of seven industrial countries' imports subject to nontariff barriers, by product group, 1983

Country	Agriculture	Manufacturing	Textiles	Iron and Steel
		(percent)		
Australia	21.6	28.6	29.1	42.5
	47.7	22.7	28.1	57.8
Austria	40.5	6.1	15.1	0.0
	39.9	2.4	0.0	0.0
EC	26.9	29.9	68.0	31.9
	47.7	15.2	15.6	51.8
Japan	53.3	4.4	13.0	0.0
	36.8	9.7	11.0	0.0
Norway	15.4	20.9	59.5	20.6
	27.0	3.2	39.5	0.0
Switzerland	67.3	19.5	45.8	7.7
	74.9	17.4	60.8	3.8
United States	25.1	18.6	64.0	48.9
	23.5	16.5	31.1	35.6

Source: Selected data from Julio J. Nogues, Andrzej Olechowski, and L. Alan Winters, *The Extent of Nontariff Barriers to Imports of Industrial Countries*, World Bank Staff Working Papers 789 (Washington, D.C.: World Bank, 1986), p. 52.

Note: Upper numbers refer to imports from developing countries, lower numbers to imports from industrialized countries.

Table 4—Percentage of seven industrial countries' imports of agricultural products subject to nontariff barriers, by type of measure, 1983

Country	Quantitative Restrictions	Decreed Prices[a]	Tariff Type[b]	Monitoring[c]
		(percent)		
Australia	21.4	0.2	0.0	0.0
	44.8	1.7	0.0	3.0
Austria	37.8	3.0	1.2	0.0
	14.3	24.6	9.1	0.0
EC	14.1	13.4	6.6	2.7
	21.3	27.2	8.0	2.2
Japan	46.0	0.0	7.9	0.0
	31.4	0.1	6.2	0.0
Norway	14.4	5.2	5.6	0.2
	24.9	5.0	3.6	0.5
Switzerland	19.4	0.2	0.9	50.3
	47.0	8.8	2.6	26.7
United States	18.1	15.2	3.8	3.3
	8.7	4.1	2.2	13.0

Source: Selected data from Julio J. Nogues, Andrzej Olechowski, and L. Alan Winters, *The Extent of Nontariff Barriers to Imports of Industrial Countries*, World Bank Staff Working Papers 789 (Washington, D.C.: World Bank, 1986), p. 55.

Note: Upper numbers refer to imports from developing countries, lower numbers to imports from industrialized countries.

[a] Variable levies, minimum import and export prices.

[b] Tariff quotas, seasonal tariffs.

[c] Price and volume investigations, surveillance, antidumping, and countervailing duties.

and technical or sanitary standards. (More detail is provided in Nogues, Olechowski, and Winters 1986, 7.) Especially the omission of quality standards and state trading is likely to seriously underestimate the extent of nontariff barriers for agriculture. (See Bale and Koester 1983 for an assessment of the importance of nontariff barriers for agriculture.)

Recently, domestic production subsidies have also grown in importance for agricultural trade, threatening to nullify or impair market access in an indirect way, other than through border protection. For example, in early 1988 the United States was about to bring before the GATT a dispute it has had for some time with the EC regarding production subsidies by the EC to soybeans and other oilseeds. The subsidies are considered by the United States to be a violation of Article XXIII of the General Agreement because they have effectively nullified or impaired the zero-tariff binding the United States received from the EC on these products during the Dillon Round.

High tariff and nontariff protection are indicative of a massive diversion of resources in favor of agricultural support programs. Table 5 provides some idea of the order of magnitude of the financial transfer for the larger OECD countries. It should be noted at the outset that not all expenditures listed in the table are equally trade distorting. Deficiency payments, for example, which fall under the category "price and income support," distort trade less than variable levies that give rise to domestic surpluses and their eventual disposal via export subsidies. Subsidies to domestic consumers, a big expenditure item of the U.S. agricultural program and included under the item "processing, marketing, consumer aid," even counteract some of the trade-distorting effect of agricultural support programs.

The figures on taxpayer and consumer expenditures in Table 5 are for the period 1979-81. Although they are lower than the presently incurred costs for most countries, they have the advantage of being roughly comparable across countries. In particular, the EC and Japan clearly stand out in that their consumer expenditures are particularly high relative to taxpayer expenditures. This reflects in part their heavy use of frontier barriers to trade relative to other

Table 5—Financing of agricultural policy by seven industrial countries, - 1979-81 average

Expenditures	Australia	Austria	Canada	EC-Total[a]	Japan	New Zealand	United States
Taxpayer expenditures							
Total (ECU billion)	0.47	0.49	1.64	21.15	10.19	0.25	19.39
Share due to—							
Processing, marketing, and consumer aid (percent)	7.0	1.9	14.9	10.2	1.6	0.1	54.6
Price and income support (percent)	21.7	69.3	51.8	56.8	43.8	33.3	18.3
Research and extension (percent)	46.4	2.9	10.6	6.0	3.3	19.9	4.2
Other[b] (percent)	24.9	25.9	22.7	27.0	51.3	46.7	22.9
Consumer expenditures (ECU billion)	0.2	0.9	0.9	35.8	16.7	0.0	7.0
Total expenditures[c]							
Per capita (ECU)	43	188	103	208	204	79	115
Per worker in agriculture (ECU)	1,558	4,786	4,203	7,465	4,090	1,778	7,453
Per hectare (ECU)	1.3	384.2	35.9	613.4	4,361.5	17.0	61.3
As percent of GDP	0.5	2.6	1.2	2.8	2.9	1.4	1.3

Source: Based on data from Organisation for Economic Co-operation and Development, *National Policies and Agricultural Trade* (Paris: OECD, 1987), pp. 128, 132, 134.

Note: ECU = European Currency Unit.

[a] Includes expenditures by the European Community authorities and those of the national governments of member states.

[b] Inspection services and disease control, rationalization of production, improvement of structures, rural development, and other expenditures whose breakdown by category of expenditure is not available.

[c] Includes taxpayer and consumer-financed expenditures.

countries (Table 3). Heavy reliance on border measures is likely to be more disruptive to international trade than nonfrontier barriers. Yet from the viewpoint of domestic politics, such measures look rather attractive. Not only can border measures be more easily justified in terms of food security, they also make it easier to maintain larger agricultural support programs because their financial burden is borne by generally uninformed and hence docile consumers rather than by possibly not-so-docile taxpayers.[5]

The share borne by consumers via higher prices is far more difficult to ascertain than federal budget allocations to agricultural support programs that are subject to highly public discussions. Hence, viewed from this perspective, higher levels of agricultural support would be expected in countries relying more heavily on consumers than on taxpayers to pay for agricultural support. This seems to be borne out in reality. Austria, the EC, and Japan, the three countries that make their consumers bear the brunt of the financial burden of agricultural programs, also have the highest overall expenditures on agricultural support programs, both per capita and per hectare of cultivated land.

Tables 6 and 7 provide a glance at fiscal expenditures over time for the EC and the United States, respectively. (Note that, unlike Table 5, Table 6 considers only the supranational expenditures of the EC. National expenditures in addition to these are included in Table 5.) Unlike the more comprehensive Table 5, Tables 6 and 7 refer only to expenditures for price and income support. For the EC as a supranational institution, this category comprises about three quarters of all fiscal expenditures on agriculture. By contrast, it is much less important for the United States, although it has increased in significance since the passage of the 1985 farm bill.[6] Most of the expenditures of the United States are concentrated downstream from farm production. They are used to improve sales of agricultural products through marketing assistance, better processing infrastructure, market research, and, in particular, through consumption subsidies (Table 5).

Tables 6 and 7 not only document the growth in fiscal expenditures on agriculture, both in absolute terms and relative to gross domestic product (GDP), they also give a rough idea of the distribution by commodity of these expenditures. For both the United States and the EC, dairy products and cereals receive most of the support payments. As a result, it is not surprising to find that the world markets for these products are among those that are the most distorted.

Table 8 provides some recent estimates of the degree of world market distortion for some cereal and dairy products and a few others. The figures in the table give just an order of magnitude; differences in methodology and data base can lead to somewhat different results without, however, changing the basic message that many markets for agricultural products are heavily distorted by government intervention.[7] World market prices and trade flows, rather than comparative advantage, have come to reflect the relative ability of countries to subsidize. Market access has become highly uncertain for exporters, thereby inflicting a heavy burden on nonsubsidizing exporters, including numerous highly indebted developing countries. In addition, market or price stability has been lost as world markets increasingly degenerate into

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[5] See Hayami 1986, 37-38. Note, however, that export subsidies, although classified as frontier barriers, are financed out of tax revenue.

[6] For the years 1979 through 1981, the average percentage of U.S. fiscal expenditures in this category was only 18.3 percent according to Table 5. With the farm bill of 1985, however, this ratio has increased, as expenditures for income and price support have risen about sevenfold from 1979-81 to 1986-87.

[7] Numerous quantitative studies have appeared in the 1980s, among them Valdés and Zietz 1980; Organisation for Economic Co-operation and Development 1987; and Tyers and Anderson 1986. A convenient survey of quantitative results is provided in Valdés 1987. A very readable account of the anomalies of international agricultural trade is provided by Miller (1986).

Table 6—Gross expenditures by the EC for price support and income transfers, 1974-87

Type	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
							(EUA/ECU billion)[a]							
Outlays of EAGGF[b]	3.1	4.7	5.6	6.8	8.7	10.4	11.3	11.0	12.4	15.8	18.4	19.7	22.1	23.0
							(percent)							
As share of EC GDP	0.34	0.46	0.44	0.48	0.55	0.59	0.57	0.49	0.51	0.61	0.66	0.66	0.63	0.62
Share of—														
Restitutions[c]	19.0	20.5	26.2	37.5	40.8	47.7	50.6	46.8	40.8	33.8	34.5	33.8	33.5	39.8
Interventions[d]	81.0	79.5	73.8	62.5	59.2	52.3	49.7	53.2	59.2	66.2	65.5	66.2	66.5	60.2
Share of—														
Dairy products	39.4	24.3	40.8	42.8	46.3	43.4	42.0	30.0	26.8	27.6	29.6	29.9	24.4	26.6
Beef	10.5	20.7	11.0	6.8	7.4	7.2	12.0	12.9	9.3	10.9	13.9	13.8	15.7	10.2
Cereals	12.9	13.1	11.7	9.2	12.8	15.0	14.8	17.2	14.7	15.3	9.0	11.6	15.3	15.9
Sugar	3.5	6.5	4.1	8.8	10.1	9.0	5.1	6.9	10.0	8.3	8.9	9.1	7.8	7.1
Oils and fats[e]	4.6	4.9	5.5	4.5	3.7	5.8	6.1	9.2	9.8	10.2	9.5	9.1	11.8	13.2
Fruit and vegetables	2.2	1.9	3.3	2.6	1.2	4.2	6.1	5.8	7.4	7.5	7.3	6.2	4.4	4.2
Wine	1.4	2.9	2.4	1.3	0.7	0.6	2.6	4.1	4.6	4.1	6.6	4.7	2.8	5.5
Other products	25.7	25.5	21.1	24.0	17.8	14.9	11.3	13.9	17.4	16.1	15.2	15.6	17.8	17.3

Source: Based on data from Commission of the European Communities, *The Agricultural Situation in the Community,* various issues (Brussels and Luxembourg: CEC, various years).

[a] From 1974 to 1978, expenditures are given in European Units of Account; from 1979 to 1987, they are in European Currency Units. Figures do not include expenditures by national governments.

[b] European Agricultural Guidance and Guarantee Fund; the figures exclude expenditures of the "guidance section."

[c] Export subsidies.

[d] Including stock holding, less production levies for milk.

[e] Includes expenditures for olive oil.

Table 7—Net expenditures by the United States for price support and income transfers, 1974-87

Type	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
							(US$ billion)							
Total expenditures[a]	1.0	0.6	1.0	3.8	5.6	3.6	2.7	4.0	11.6	18.8	7.2	17.6	25.8	22.4
							(percent)							
As share of U.S. GDP	0.07	0.04	0.06	0.19	0.25	0.15	0.10	0.13	0.37	0.56	0.19	0.44	0.61	0.50
Share of[b]—														
Maize	44.2	26.1	11.0	10.5	30.2	24.3	46.2	[c]	36.9	30.5	. . .	25.1	40.7	55.1
Wheat	20.8	4.4	6.9	49.8	14.9	8.4	31.9	38.5	19.2	18.2	35.1	26.4	13.3	12.7
Dairy products	4.6	73.8	4.0	12.3	4.3	0.7	37.2	47.4	18.8	13.5	20.9	11.9	9.0	5.2
Cotton	72.2	40.5	0.8	2.7	4.0	4.0	2.4	8.4	10.3	7.3	3.4	8.8	8.3	8.0
Soybeans	2.6	. . .	. . .	0.1	0.6	0.1	4.3	2.2	1.5	1.5	. . .	4.0	6.2	. . .

Source: Selected data from Joachim Zietz, "Der Agrarsektor in den GATT-Verhandlungen," *Die Weltwirtschaft* 1 (June 1987): 200-211.

Note: Expenditures on PL480 food aid are excluded.

[a] Gross expenditures minus repayments of credit.

[b] Shares of the net expenditures do not sum to 100.

[c] Receipts exceed expenditures because of repayment of credit.

Table 8—Price and trade effects of agricultural protection, by various products and countries, 1980-82

Effect	Wheat	Feed-grains	Rice	Beef and Veal	Dairy Products	Sugar
				(percent)		
Change in world market price	-9	-3	-10	-21	-38	-10
Change in world trade volume	6	-9	-15	-63	-39	-3
			(million metric tons)			
Absolute change in export volume						
Group 1[a]	4.5	4.0	3.8	5.6	14.0	2.3
Group 2[b]	3.0	-8.6	0.2	-2.1	14.4	0.7
Group 3[c]	-2.6	1.9	-0.0	-0.5	-6.2	-0.0
Group 4[d]	-4.9	2.3	-4.0	-2.9	-22.0	-2.9

Source: Based on data from Rodney Tyers and Kym Anderson, "Global Interactions and Trade Liberalisation in Agriculture," University of Adelaide, April 1987 (revised mimeo).

[a] Western Europe (12 countries in the European Community, 5 in the European Free Trade Association), Japan, Korea, Taiwan.

[b] Australia, New Zealand, Canada, United States.

[c] Centrally planned economies of Eastern Europe.

[d] Other developing countries.

dumping grounds of domestic farm policies that have run out of control.[8] It is not surprising then that agricultural trade has become the area of many, if not most, trade disputes and conflicts in recent years.

What have been the reasons for the persistence and growth of agricultural protection? This question is not trivial; the costs of protection are large and extend beyond agriculture into other sectors of the economy.[9] In addition, the agricultural population is rather small in most industrial countries and is continuing to shrink. For example, the average percentage of the labor force employed in agriculture for the 19 countries classified as Industrial Market Economies by the World Bank was only 6 percent in 1981, compared with 14 percent in 1965 (World Bank 1985, 215). Nevertheless, farmers seem to be able to muster considerable political clout.

To a large degree the political influence of farmers simply reflects a rational complacency on the part of consumers. Although consumers potentially gain the most from trade liberalization, there are well-known problems in rallying their support: (1) lack of appropriate information regarding the costs of agricultural protection for food prices, but also for job creation in nonagriculture, results in small perceived personal gains from liberalizing agricultural trade; (2) other things being equal, the costs of agricultural protection per capita decrease with rising incomes because the income elasticity of demand for agricultural goods is generally less than unity; (3) high transaction costs make it difficult to organize a large body of people with diverse interests, such as consumers, as opposed to a smaller and shrinking group with distinct concerns in just one subject; and (4) the income loss that results from agricultural protection may be considered akin to an insurance premium that buys social solidarity if an individual's job should be in danger. (See Hayami 1986 and Honma and Hayami 1986 for more detailed analyses of these problems.)

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[8] Quantitative evidence on the instability of world agricultural markets as it results from import protection is provided in Schiff 1985. See also Tyers and Anderson 1987.

[9] The analysis of the costs of agricultural protection to sectors outside of agriculture is rather new. Examples of this type of work were recently presented at a joint conference of the American Enterprise Institute and the Center for International Economics (Australia) on "Agricultural Policies and the Non-farm Economy" in Washington, D.C., May 26-27, 1988. For example, see Stoeckel and Breckling 1988 and Donges et al. 1988.

The aspect of solidarity also goes some way in explaining why protection in agriculture, however costly it may have come to be, meets with little resistance from other sectors and industries. As long as persistent protection in agriculture does not directly affect other industries in the form of reduced subsidies or forgone profits of significant magnitude, little change can be expected in their acceptance of agricultural protection. In sum, an insufficient degree of domestic countervailing power, that is, the lack of a forceful and influential antifarm lobby, is a reason, if not the main one, for the political clout of farmers.[10]

Apart from that, the growth of agricultural protection can be traced mainly to two factors: the decline in the relative size of the agricultural sector and trade retaliation. A decrease in the relative size of the agricultural sector allows, all else being equal, for an increase in protection without requiring a change in the level of budget outlays. Retaliation for one country's protective actions may partially or fully eliminate the intended effect of the protection. Hence, in a world where trade retaliation is the rule rather than the exception, securing a certain protective effect to farmers may require, if not an ever-increasing level of protection, then certainly an ever-increasing level of budgetary outlays (Tables 6 and 7).

Even the high degree of protection currently applied in many industrialized countries and their considerable budgetary outlays do not appear to be sufficient to compensate for the effect of similar actions in most industrialized countries. Indeed, retaliatory actions have resulted in making farmers worse off now than they were years ago. Despite escalating costs, recent experience in many industrialized countries has seen declining rather than rising farm incomes (Organisation for Economic Co-operation and Development 1987, 59). In addition, there is no evidence that agricultural policies have managed to reduce income disparities within agriculture, one of the prime reasons for government intervention in the market in the first place. Instead it appears that the large, well-to-do farmers are reaping most of the benefits of governmental programs, thereby making agricultural protection a highly inefficient redistribution scheme (see Koester and Nuppenau 1987). A recent study found, for example, that for both the United States and the EC more than 75 percent of agricultural assistance is received by less than 25 percent of all farmers (Organisation for Economic Co-operation and Development 1987, 59).

Reactions to Mounting Protection

Mounting budgetary costs, disruptive trade disputes, and the realization that the target group of agricultural market intervention is not reached to the intended degree seem to have made industrialized countries more perceptive of the need for agricultural trade reform in recent years. In line with this sharpened awareness, work on a new multilateral trade round started in the Committee on Trade in Agriculture in 1982, when it was established within the GATT framework by a ministerial conference. At about the same time the OECD Secretariat was given the mandate by its Ministerial Council to analyze the effects of agricultural protectionism and ways to improve the functioning of world markets for agricultural products.

Efforts for a new trade round culminated in the Special Session of the GATT Contracting Parties in Punta del Este (Uruguay) in September 1986. On the occasion of this special session the ministers of GATT member countries adopted a declaration launching a new round of multilateral trade negotiations—the Uruguay Round. The main results of the constituting meeting in Punta del Este, as they relate to agriculture, broadly reflect the concerns expressed in recent research: improving market access, reducing direct and indirect subsidies with trade impact, and minimizing the trade impact of health regulations and standards.[11] That an agreement was reached at all in Punta del Este is by itself no small surprise, given the diversity of interests represented at the conference. However, identifying the agenda for action, although a necessary first step for reform, is not equivalent to agreement on the needed course of action. After all, disagreement on the appropriate policy reforms is not limited to policymakers of different countries, but also figures prominently among economic researchers.

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[10] For a discussion of the political-economy problems in the EC, see Schmitt 1986. A more comprehensive study that includes the United States is Petit 1985.

Almost two years after the Punta del Este declaration, overall progress is rather modest. Separate negotiating groups have been set up for each of the 14 "Subjects For Negotiation" mentioned in the Punta del Este declaration (see Appendix 3 for a list of these subjects). Of these, four are sector- or commodity-specific—the groups for tropical products, natural resource-based products, agriculture, and textiles and clothing. It may be noted that agricultural products are discussed in three of the four groups. Other negotiating groups are dealing with barriers to trade, such as tariffs, nontariff barriers, and subsidies, and yet others with GATT articles, safeguards, and related matters.

Within the various groups, much of the time has been spent on taking stock of the various proposals that have been put forth by the contracting parties. Depending on the complexity of the issues, progress is rather varied among the groups. The group on tropical products,[12] for example, which is of central importance for many low-income developing countries, seems to have progressed rapidly. (See Valdés and Zietz 1980 for the quantitative importance of the tropical products group for LDCs.) It even seems possible that an initial round of tariff reductions can be put into effect for tropical products by 1989. By comparison, the negotiating group on agriculture, which is of central interest to most industrialized and many higher-income developing countries,[13] took until the end of 1987 just to collect the reform proposals of the main participants in international trade.[14]

Six major reform proposals have been tabled in the negotiating group for agriculture (an overview of these proposals can be found in U.S. General Accounting Office 1988). They come from the United States, the Cairns Group,[15] Canada,[16] the Nordic countries,[17] the EC, and Japan. The proposals can be grouped into two broad categories, one with a comprehensive scope covering all commodities and calling for the removal of all trade-distorting measures, and one with a narrower scope, particularly regarding the removal of import restrictions and domestic subsidies. The proposals of the EC, Japan, and the Nordic countries fall into the latter category, the remaining proposals into the former.

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[11] The complete text of the Punta del Este Declaration can be found in GATT Secretariat 1986. An abbreviated version of the Ministerial Declaration on the Uruguay Round with citations of those passages of particular interest in the context of this study is presented in Appendix 3.

[12] Seven product groups are part of this negotiating group: tropical beverages (coffee, cocoa, and tea); spices, flowers, and plants; certain oilseeds, vegetable oils, and oilcakes; tobacco, rice, and tropical roots; tropical fruits and nuts; tropical wood and rubber; and jute and hard fibers.

[13] Higher-income developing countries are mainly affected as exporters. The concerns of many food-importing low-income developing countries, whose terms of trade would deteriorate with restrictions on export subsidies, have been given rather scant attention so far in the negotiating group on agriculture, although Jamaica, supported by a number of other developing countries, has put forth a communication to this effect. See GATT Secretariat 1988b, 6.

[14] The second phase of the negotiating group for agriculture, which began in February 1988, will concentrate on the actual negotiations. It has no fixed completion date.

[15] The Cairns Group was established in Cairns, Australia, in August 1986. Its members are Argentina, Australia, Brazil, Canada, Chile, Colombia, Hungary, Indonesia, Malaysia, New Zealand, the Philippines, Thailand, and Uruguay. The countries of the Cairns Group represent some 550 million people and account for roughly one quarter of the total amount of agricultural exports.

[16] Although a member of the Cairns Group, Canada proposed a more detailed plan of its own.

[17] This group consists of Finland, Iceland, Norway, and Sweden.

The most sweeping proposal comes from the United States (see the statement of Undersecretary of Agriculture Daniel Amstutz in U.S. Department of Agriculture 1987). It calls for the elimination, gradually over 10 years, of all barriers to agricultural imports and of all farm subsidies that distort agricultural trade either directly or indirectly.[18] In adopting the measurement concept of the OECD Ministerial Mandate study (Organisation for Economic Co-operation and Development 1987), the U.S. proposal suggests converting all support programs to a common denominator, such as the Producer Subsidy Equivalent (PSE), which is discussed in detail in Chapter 5. Exempted from this are programs with little or no effect on production and trade, such as certain forms of food aid and income supplements not linked to production. The proposals by the Cairns Group and Canada are similar to the U.S. proposal in principle. (The idea behind the Cairns Group proposal is discussed in some detail in Reeves 1987.) These proposals also subscribe to some degree or other to the measurement concept of PSE or modifications thereof. In contrast to the U.S. proposal, however, they also contain some suggestions for short-term measures, such as a freeze on import restrictions and all subsidies affecting trade.

The EC position is far removed from that of the United States. In fact, compared with the U.S. proposal it is at the opposite end of the spectrum. Its main focus is short run rather than long run. What the EC proposes, at least in a much-emphasized initial phase, is essentially a system of market management, that is, an item-by-item agreement on minimum prices and market sharing for those commodities for which the world market appears to be particularly distorted—grains, dairy products, and sugar. (Part of the short-run solution appears to be the EC's desire to harmonize protection levels for grains and grain substitutes, which implies raising the protection levels for grain substitutes to those for grains.) In a second phase, the EC envisions some longer-term concerted reduction, though not elimination, of farm support programs. However, the EC has not made it clear how the second phase is linked to the first. Despite the general vagueness of the EC proposal, it seems clear that the EC is not willing to discuss the basic structure of the Common Agricultural Policy.

The trade reform proposals of Japan and the Nordic countries have in common with the EC proposal that they do not call for the complete elimination of all import restrictions and domestic subsidies, but only for their reduction. Both are disposed toward severe restrictions on export subsidies because that is where they appear to see the main root of the current problems in agricultural trade—a position that essentially reflects their status as net importers of agricultural products. The Nordic countries support the aggregate negotiating approach, favored also by the United States, for reducing levels of support based on PSE or similar measures. Japan, in contrast, has rejected the PSE approach to the negotiations on the grounds that it could not reflect the special characteristics of a country's agriculture.

Given the disagreement over agricultural trade reform between the United States and the EC, the two main players in the negotiations, the initial optimism after the signing of the Punta del Este declaration seems to have given way to pessimism and frustration.[19] Apart from the EC and Japan, most participants appear to favor at this time a closer look at the usefulness of the PSE measurement concept, which was at the center of the OECD Ministerial Mandate study. The hope behind this seems to be that by establishing a general approach to the negotiations in agriculture, the current deadlock can be overcome.

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[18] In addition, the United States proposes harmonizing health and sanitation regulations among GATT signatories so that differences cannot be used as indirect trade barriers. This idea is not controversial among the participants of the Uruguay Round. Essentially all countries have a similar element in their own proposals.

[19] See, for example, *Agra Europe*, March 18, 1988, E/1-E/2.

This idea may of course be generalized for the whole Uruguay Round. What appears to be missing at this point is a simple central theme or unifying principle, similar to the across-the-board tariff-cut idea of the last two multilateral trade negotiation rounds. It may be asked to what extent concepts such as PSE that appear attractive for agricultural products, but only agricultural products, will not enhance but inhibit progress for the Uruguay Round as a whole by preventing agreement on a truly general reform concept that is applicable across all products. It seems that not only the negotiating group on agriculture is in need of a unifying concept or a clearer set of guideposts by which to organize its discussions. Other negotiating groups appear to face a similar problem.

The following two chapters undertake to facilitate the process of finding such a unifying principle for the Uruguay Round by clarifying some of the more important issues surrounding various proposals for trade reform in agriculture, providing some needed structure to the debate on diverse proposals, and discussing the likely economic consequences and political-economy implications of some ideas for reforming agricultural trade within the GATT.

4

CRITERIA FOR EVALUATING TRADE REFORM PROPOSALS

Conformity With GATT Principles

The GATT is built around a number of fundamental principles that form the backbone of the current trading system. Nondiscrimination by country of origin and a general ban on quantitative import restrictions are the two most important of these principles. During a time when trade disputes seem to be a regular occurrence, the disciplines that these principles are supposed to impose on the trading system and its participants appear to be eroding (see Teese 1982). GATT rules based on these principles are simply being ignored—for example, the provisions of the safeguard clause of Article XIX—or they are being circumvented by resort to gray-area measures such as voluntary export restraints.

In the light of this erosion process, at least one school of thought, popular in the EC, draws the conclusion that the growing disregard of GATT rules can be stopped only by rewriting them in a way that relaxes their reliance on pristine principles such as nondiscrimination. The idea is to bridge the apparent gap between reality and the rules of behavior mandated by the General Agreement by adjusting the rules so they better reflect reality (see the discussion in Adlung 1987). In practical terms this means, for example, eliminating the nondiscrimination or compensation provisions from the safeguard clause of Article XIX. This would increase, it is argued, the incentive to stick to Article XIX, or its watered-down revision, rather than to opt for mechanisms outside of GATT, such as voluntary export restraints. Experience with vague GATT rules in agriculture, however, does not give much credibility to this view. On the contrary, the experience of agriculture amply demonstrates that vaguer, less-demanding formulations of GATT rules that chip away at the fundamental principles of the General Agreement are more likely to provoke serious trade disputes or even trade wars than to bring about more GATT discipline. Hence there is evidence to suggest that weakening the rules of behavior mandated by the General Agreement and its underlying principles is a serious mistake.

A better alternative may be to try to reinforce the GATT and its basic principles through improved operational rules and regulations. Improvement in this sense does not mean compromising the principles of the General Agreement through weakened rules of behavior but rather making the rules that incorporate these principles more compatible with the incentives governments face. The principles themselves are too important to be given up. Their significance for a proper functioning of the GATT system is discussed in the remainder of this section.

Nondiscrimination

The cornerstone of the GATT trading rules is the principle of nondiscrimination, also known as the principle of "unconditional most-favored-nation" (MFN) treatment. It requires that any trade advantage granted to one signatory of GATT be extended to all others. Likewise, import restrictions apply equally to imports from all sources. The MFN principle ensures equal trading opportunities for all signatory countries and provides a multilateral as opposed to a bilateral framework for the international trading system.

The importance of the MFN principle for the international trading system can hardly be overestimated. It is by far the simplest and, if enforced properly, probably one of the most effective ways of moderating the growth of protectionism. Indeed, the spread of protectionism can be traced largely to the growing disrespect for the MFN principle.[20] Voluntary export restraints or selective import restrictions are examples of blatant violations of the MFN principle. A single country or a few of the most efficient and hence lowest-cost exporting countries are singled out under these schemes and subjected to trade restrictions.

Strict adherence to the MFN principle would mean imposing import restrictions on all trading partners in an equal manner, with two important consequences. First, it would mean treating the most efficient and hence lowest-cost producer in the same way as less efficient producers, thereby improving the efficiency of international resource allocation. Second, the level and duration of import protection would probably be reduced. As all actual and potential suppliers would be affected by import restrictions, more political pressure would be put on the import-restricting country than is applied in a system dominated by bilateral trade agreements.

Stepped-up pressure would most likely result from three sources. First, the largest trading nations with the most political power would be subjected to the same restrictions as smaller and politically less influential countries. This would raise significantly the price to be paid by protecting countries for additional import protection. A particular special interest group, such as grain farmers or the farm lobby in general, would have a harder time convincing politicians of the merit of protectionist measures in their area of interest when retaliation by a potent trading partner was threatening to damage the trade interests of other special interest groups in the country, such as meat producers or machine tool manufacturers. Second, global restrictions would eliminate the quota rents that many exporters now receive as partial compensation for their export restraint. As these rents can be substantial,[21] their removal would make exporters much less likely to quietly accept restraint agreements. Third, nondiscriminatory protection is making it easier for consumers and voters to identify the true economic costs of protection. Better knowledge may provide an additional impetus to the eventual removal of import protection. (See Banks and Tumlir 1986 for a discussion of this and other advantages of the MFN principle for international trade.)

Since the MFN principle has great potential for restraining protectionism, it is worth every effort to strengthen it. This would include, among other things, avoiding the introduction of new rules that are either not in full agreement with the MFN principle or are silent on it, thereby allowing signatory countries to easily avoid its disciplines. Chapter 5 includes a discussion of the possibility that rewriting the GATT rules for agriculture around the concept of PSEs could weaken the force of the MFN principle.

The history of the General Agreement demonstrates that full and unconditional enforcement of the MFN principle is not easy to achieve. It may conflict with such matters as customary procedures in international trade, the interests of powerful lobbies, and conceptions of fairness. For example, a common argument against an unconditional application of the MFN principle in agriculture is the potential terms-of-trade loss for LDCs with preferential access, under the Lomé agreement, to the market of the EC. (The Lomé Convention provides 44 African, 13 Caribbean, and 8 Pacific countries with preferential access to the EC market.) However, this argument against the MFN principle is based on weak foundations, for several reasons. First, any move toward trade liberalization is likely to increase world price compared with what it would otherwise be.[22] This alone would provide exporting LDCs with some degree of compensation for the loss of preferential access.

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[20] The MFN principle has never had much force behind it in the GATT system, particularly not in the parts of the General Agreement that sanction trade restrictions in specified circumstances, such as Article XIX.

[21] For example, Hong Kong's quota rents derived from textiles and clothing amount to approximately 2 percent of gross national product. See Hamilton 1986.

Second, there is some evidence that preferential access may actually distort the domestic allocation of resources in LDCs (Dick, Gerken, and Vincent 1982). Economic growth is guided by artificial price signals that may have little relationship to world market conditions in the absence of protection. Preferences then lead to artificial, possibly unsustainable, economic structures in LDCs, requiring restructuring measures that are costly both in economic and political-economy terms once protection in importing countries is dismantled. Unconditional MFN treatment would eliminate this distortion and hence might raise potential real income.

Third, the EC could compensate LDCs directly via income transfers for any remaining income loss. It is unlikely that the required budgetary costs of such a transfer program would exceed the additional market support expenditures currently needed to maintain the preferential access schemes in the face of mounting domestic surpluses. For example, the benefits of the Lomé Convention to the African, Caribbean, and Pacific (ACP) countries that receive preferential access to the EC are not considered to be significant on average. This does not mean that there are not some countries that do capture substantial benefits in certain products (see Koester and Herrmann 1987).

Direct compensation is likely to be possible also in lieu of the Generalized System of Preferences (GSP),[23] especially if the newly industrialized countries are eliminated from the list of countries receiving tariff preferences. As they now reap most of the benefits of the GSP,[24] their graduation would cut any potential compensation payments to a minimum. The GSP scheme seems dispensable also on other grounds. It includes only tariffs, not quotas. Unlike the EC-ACP convention of Lomé, the GSP gives LDCs little certainty about the preferences. Since the GSP is not part of a binding commitment under the GATT, but is a completely voluntary concession, it may be revoked at the discretion of the preference-giving country at any time. Clearly, this introduces a great deal of uncertainty and is therefore not conducive to long-run investment decisions in preference-receiving countries.

Finally, preferential-access schemes, regardless of the type, have a definite drawback from a political-economy viewpoint. They tend to promote an alliance of preference-giving and preference-receiving countries against MFN reductions in protectionism. Such reductions are likely to hurt the short-run interests of both import-competing sectors in the protecting country and exporters with preferential access to these protected markets. Both groups are likely to be well organized in their respective countries relative to consumers and other groups that are affected negatively, but less directly, by a system of protection cum preferences. Therefore, governments in protecting countries face little countervailing pressure for a removal of protection, either from within the country or from exporting countries. Preference schemes can thus be a formidable obstacle on the way to an elimination of trade barriers in a multilateral setting.

Although complete and unconditional implementation of the MFN principle will not be easy to achieve, its further erosion has to be avoided because the costs of scrapping the MFN idea are high, both for industrialized and developing countries. The trade regime covering textiles and clothing (known as the Multifiber Arrangement) provides an example of the costs to the international trading system if basic GATT principles such as nondiscrimination are given up.[25]

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[22] The many studies on the effects of trade liberalization in agricultural products all point in this direction. See Leddy and Reinstein 1987, Organisation for Economic Co-operation and Development 1987, Hudec 1987, Finger and Olechowski 1987, and Valdés 1987.

[23] Opinions vary widely on this. See, for example, GATT Secretariat 1985.

[24] Details are given in, for example, Langhammer and Sapir 1987.

[25] Donges et al. (1981) provide a summary account of the issues surrounding the trade regime in textiles and clothing. Spinanger and Zietz (1986) give a shorter description with some illustrative figures.

Put into effect in 1974, prolonged and extended in coverage as well as severity four times since then, the Multifiber Arrangement is the prime example of a sectoral, discriminatory system founded on the principle of managed trade. (A comprehensive discussion of the Multifiber Arrangement and its economic costs can be found in Wolf et al. 1984.)

Managed trade of the Multifiber Arrangement type is synonymous with a tangle of bilateral contracts, with industrialized countries setting their terms. Essentially all efficient, low-cost, developing-country exporters are forced into "voluntary" export restraint agreements, thus leading to the virtual cartelization of the textiles and clothing trade and leaving little if any room for the forces of competition. Also lost on the way is the simplicity of trading in a world of bound tariffs known in advance with certainty to all traders, established and potential. Managed trade under the Multifiber Arrangement has brought relative security of access for a few established exporters, but at the expense of a maze of bureaucratic trade rules and regulations that even experts find ever harder to understand and keep track of. In a word, experience has shown managed trade to be far removed from the letter and spirit of the General Agreement. Its high economic costs make the alternative, that is, the MFN principle, look like a very good deal economically.

Reliance on the Price Mechanism

A second important principle of the GATT is its reliance on the price mechanism as opposed to quantitative rules characteristic of managed trade. This principle is expressed in the use of bound tariffs as the GATT's main form of protection, whereas quantitative barriers to trade are limited to exceptional cases (see Article XI and the corresponding explanatory notes in Appendix 1). The rationale behind this principle is straightforward. Leaving aside for the moment the possibility of prohibitive tariffs, it helps to keep international trade market-oriented in the sense that national economic policies and the resulting trade flows are not allowed to become totally delinked from market forces. Reliance on bound tariffs ensures that the price mechanism is not suspended but merely modified, with all its well-known consequences such as transparency of import protection, predictability of market access, nondiscrimination among suppliers, sourcing from the most competitive supplier, and improved international market stability.

Although most of these results favor all exporters, they are particularly important for developing countries that may have neither the resources nor the expertise to find their way through a thicket of continually changing regulations characteristic of systems of managed trade. Last but not least, bound tariffs as the principal form of protection provide a good basis for further liberalizing trade. Negotiations on tariff reductions are vastly less complicated than negotiations involving quantitative import restrictions like those characteristic of managed trade.

It should be stressed at this point that it is their binding that makes tariffs consistent with the spirit of the General Agreement. Only tariff binding guarantees that the price mechanism is allowed to operate. Notice in this context that variable levies are also tariffs. Yet the fact that they are not bound, but vary along with the world price, makes them equivalent in their effect to quantitative restrictions. They do not allow the price mechanism to operate. On the contrary, they completely insulate the domestic market.

Tariff binding has an important aspect apart from ensuring that the price mechanism is allowed to function. It operates as a natural shield for governments against demands by special interest groups for higher levels of protection. This is because bound tariffs cannot be raised without cost. Once a tariff concession has been made, that is, once a tariff is bound, it cannot be rescinded without extending compensation to the affected trading partners. In the absence of compensation a country faces retaliation (see GATT Articles XIX and XXVIII in Appendix 1).

Compensation is also mandatory when measures are adopted that nullify or impair the value of the tariff binding to the trading partners (Article XXIII). An example of such a measure would be the tax on soybean and soybean products contemplated by the EC in the early 1980s to circumvent the zero-tariff binding on these products that was granted to the United States at the end of the Dillon Round in return for its acceptance of the Common Agricultural Policy. This tax on vegetable fats would have nullified the tariff binding and hence mandated compensation payments to the United States. Because of the clear stand on this by the United States and its threat of massive retaliation in the absence of adequate compensation, the EC dropped the idea of a vegetable oil tax.

Concentration on Direct Trade Effects

Another element of the GATT is its emphasis on the reduction of government market interventions with a direct, as opposed to an indirect, trade effect. Those with a direct effect, also known as frontier barriers, consist of trade-inhibiting measures that are commonly applied at the border—such as import and export taxes, quotas, and export subsidies—and discriminate between domestic and foreign sources of supplies or between domestic and foreign destinations. (For a thorough discussion of the distinction between frontier and nonfrontier measures, see Snape 1987, 216.) The treatment of products or factors of production depends on their nationality. Measures with indirect trade effects, that is, nonfrontier policies, are made up of taxes and subsidies on production, consumption, or factors of production. They do not generally discriminate between foreign and domestic sources or destinations. For example, a production subsidy is not conditional on the destination of the product. Also, unlike an export subsidy, a production subsidy does not discourage domestic consumption. Similarly, consumption or factor taxes or subsidies do not qualify as frontier barriers as long as they are administered without regard to nationality. (See Snape 1987 for a more comprehensive discussion as well as various qualifications.)

Free international trade as envisioned by the GATT is commonly understood to mean the absence of frontier measures. Most GATT rules and regulations address the containment and reduction of tariff and nontariff barriers to trade as well as of export subsidies and taxes, whereas only a few rules relate to nonfrontier measures, either directly or indirectly. Examples of those related to nonfrontier measures are the rules pertaining to countervailing duties and subsidies as laid down in Articles VI and XVI:1, respectively, and in the Subsidies Code. Domestic subsidies are taken up in an indirect way in Article XXIII in the context of nullification and impairment of tariff concessions.

The historical emphasis on frontier barriers derives from three considerations. First, they generally tend to be visible and therefore more tractable than nonfrontier barriers. This also makes them easier to negotiate.

Second, nonfrontier barriers are more difficult to maintain in the absence of frontier barriers because of their high budgetary costs to governments. (A detailed account of this argument is given in Snape 1987.) Indeed, the complete removal of frontier barriers would probably suffice to keep domestic subsidies in check. The high budgetary cost of domestic subsidies in the absence of border measures contrasts with the budget outlays for frontier barriers. If export subsidies are exempted, frontier barriers can not only be administered cheaply, they can even earn revenue for governments. (This is one of the reasons that border taxes, on either exports or imports, are so popular with developing countries.) They also have certain advantages over domestic subsidies from a political-economy point of view. Border measures invoke less political resistance—because their consequences are difficult to assess in quantitative terms—if they come, as is commonly the case now, in the form of nontariff barriers and their economic costs are spread widely in the economy. Subsidies, in contrast, attract more political attention—because taxes have to go up or other programs have to be cut—thereby provoking conflict with other vested interests. Since even voluntary export restraints or orderly marketing arrangements that generally worsen the terms of trade for the importer are often preferred over domestic subsidies, the strong preference of countries for border measures is clear.

Third, from a theoretical point of view, domestic subsidies have long been considered a superior means of providing assistance to domestic industry when contrasted to frontier barriers. (See Blackhurst 1981 and the references therein for a discussion of this point.) The standard arguments for domestic subsidies as opposed to frontier barriers are that they can be better targeted: they do not distort consumer prices and hence reduce imports by less than equivalent frontier barriers;[26] they are subject to annual budgetary review and hence are much more visible than protection at the border; they are more equitable, assuming the tax system itself is considered equitable; and they provide a convenient way to correct certain market imperfections or failures.

Even if one discounts for the latter arguments, the strong revealed preference of governments for frontier measures and the GATT's traditional focus on this area seem to provide enough reason to question the wisdom of devoting much attention to nonfrontier barriers in the Uruguay Round. What makes domestic subsidies less of an urgent problem is their concentration in just two areas: high technology products (the classic example is the subsidization of the Airbus project by several European countries) and agriculture.[27] But even in agriculture, the subsidy issue plays a role mainly in trade disputes between the EC and the United States.[28] In addition, it appears that essentially all subsidy disputes in agriculture between the United States and the EC result from sharply different protection levels among products in the EC's Common Agricultural Policy. For example, recent EC subsidies on oilseeds are clearly intended to nullify the zero-tariff binding on soybeans, soybean meals, and certain other feedgrain substitutes that considerably raises EC budget expenditures. It may be hypothesized that the domestic subsidy issue would largely disappear with uniform levels of protection within major groups of agricultural products.

Hence, even though domestic subsidies currently seem to be the cause for considerable friction in trade relations in agriculture as well as certain other areas of trade,[29] this may not warrant spending much time and effort in the Uruguay Round on finding a possibly illusive general solution to the subsidy problem, either within the General Agreement or the Subsidies Code. It may be preferable to negotiate subsidies between the affected parties when and where they arise and otherwise concentrate on border measures in the Uruguay Round (see Finger 1987, chap. 20).

Ease of Measurement and Enforcement

Trade reform proposals have little practical merit and are unlikely to improve the international trading regime unless the rules and regulations to enforce them can be defined or measured adequately and are fairly straightforward to monitor. Difficult problems arise with rules that leave too much room for avoidance strategies or break down as productivity or demand, or both, change over time. In the following section, these issues will be discussed in somewhat more detail.

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[26] "Equivalent" is used in the sense of granting domestic production activities an equal amount in income transfer. There are cases, however, where frontier barriers are less trade-distorting than equivalent domestic subsidies. For more detail on this subject, see Snape 1987, 222-224.

[27] Otherwise, the claim that foreign exporters are unduly subsidized appears to be used mainly by declining industries to gain border protection through countervailing duties. Several pertinent provisions of the Omnibus Trade and Competitiveness Bill of 1987, as drawn up by the U.S. Congress, seem to fall into this category. See the assessment provided in *Economic Report of the President, 1988*.

[28] There are exceptions, of course. One notable case involves the U.S. production subsidies to southern rice growers and their negative effect on the international competitiveness of rice grown in Thailand.

[29] See, for example, Blackhurst 1981.

Definitions, Measurement, and Monitoring

Reform proposals that rely for their working on exact definitions of highly controversial subjects are difficult to negotiate and to enforce once they are agreed upon. Examples of such difficult-to-define subjects are subsidies with an appreciable effect on trade flows and the equitable market share rule that conditions the use of export subsidies for primary goods. Owing to its generality, this rule has neither managed to effectively restrain countries from using export subsidies nor been of much use for dispute settlement.[30] On the whole, it is safe to say that domestic or nonfrontier policies are more difficult to define in multilateral trade negotiations than are frontier measures. The reason is that domestic policies and conventions can be quite different among countries because of historical, cultural, political, or other circumstances. In contrast, external trade is governed by rather similar rules in most countries.

Measurement and monitoring can be a problem whenever large amounts of detailed data are needed, when the required data become available only with a considerable time delay, or when there is no formal procedure established to collect the data. The measurement of domestic subsidies with a trade effect could be such a problem case. At times, the amounts actually spent are difficult or impossible to extract from official sources, given the numerous ways of hiding them. Also, the actual outlays in a budget year, as opposed to planned expenditures, often become available only after some time. Such problems usually do not arise with price data, which may be required by certain trade reform proposals. However, when prices are used for the purpose of price comparisons, other well-known problems arise. Examples are quality differences, either at a particular point in time or over time, and exchange-rate changes.

Quantity-based rules such as quotas are, in general, more easily measured and monitored—the stricter the definition, the easier the task. Whereas "equitable export market shares" can, for all practical purposes, be neither measured nor monitored, import or export quotas defined in tons per time period can be rather easily checked. Hence, for the purpose of striking "deals" among GATT members during multilateral trade negotiations, such quotas seem ideal. This may be one reason that quota-type arrangements appear to be favored sometimes by practical-minded negotiators.

Avoidance Possibilities

Ideally, the rules governing international trade should be structured so that avoiding them by applying gray-area measures (trade instruments not subject to formal GATT disciplines) will be impossible or at least very costly, both economically and politically. This is to say that there should be few loopholes, since special interest groups, in looking for ways to increase protection for their products, can always be counted on to find them. Faced with intense lobbying from such groups, however, governments rarely manage to evade the pressure to take advantage of these loopholes. Clearly, loopholes in the system of international trade obligations deprive governments of a protective shield against the political pressure of special interest groups.

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[30] For example, the first case based on the dispute-settlement mechanism of the Subsidies Code involved EC export subsidies for wheat flour. Although the GATT panel established that the EC increased its market share substantially by its use of export subsidies, the panel was unable, due to the Subsidies Code's imprecise language, to characterize the EC's enlarged market share as inequitable. In other cases, for example those involving subsidized EC pasta exports to the United States and the preferential treatment of Mediterranean citrus imports by the EC, the United States managed to obtain favorable panel decisions, yet the EC either blocked the decisions or chose to simply ignore the panel's recommendation. See Paarlberg 1987, 52-53.

Typical examples of loopholes related to frontier measures in the current GATT system are voluntary export restraints, variable levies, the activities of state trading enterprises, and the right to employ export subsidies and import quotas for agricultural products.

There are at least three ways to reduce the use of such loopholes. As mentioned earlier, the stringency of certain rules of behavior could simply be reduced, thus adjusting them toward actual behavior. This could be done for all trade or it could be limited to particular sectors. An example of the latter route is the establishment of the Multifiber Arrangement for clothing and textiles, whose negative consequences have already been outlined. The special exemptions for agricultural trade in the area of export subsidies and import quotas also fall into this category. When the General Agreement was drawn up in the 1940s, these special exemptions had the effect of adjusting the GATT rules for agriculture toward the reality of agricultural trade as it prevailed at that time. The discussion in Chapter 3 gives a short overview of the results in agriculture of adjusting rules of behavior toward actual trade practice.

Alternatively, a system based on bound tariffs could be changed over to one based on summary measures of protection, such as nominal rates of protection (NRP). This way, bound tariffs, for example, could not be circumvented by dubious state trading practices, voluntary export restraints, quotas, or similar frontier barriers. In addition, to cut the option to substitute domestic subsidies for frontier barriers, the NRP measure could be extended to cover domestic subsidies. This would lead to the fixing of overall levels of support, an idea that has recently received considerable attention in agriculture (see, for example, Organisation for Economic Cooperation and Development 1987). Although it is possible with these measures to further reduce avoidance behavior,[31] they also have certain disadvantages. One of the drawbacks of these types of overall measures is their limited applicability outside of agriculture. Limiting their use to agriculture, however, would mean establishing another special sectoral trade regime. But sectoral trade regimes are problematic from a political-economy point of view, an issue that will be taken up shortly. Also, the experience with the sectoral trade regime for textiles and clothing has not been encouraging.

A third way of dealing with loopholes in the GATT system would be to tighten existing GATT rules, such as those pertaining to state trading, export subsidies, and import quotas in agriculture; to improve the dispute settlement procedures of the General Agreement; and to introduce a limited number of new mechanisms to deal with gray-area measures such as voluntary export restraints. The idea would be to make avoidance behavior more difficult, yet stay with the General Agreement in its present form, without creating new special cases for particular sectors or industries. In Chapter 6 this third alternative is taken up in more detail as part of a comprehensive reform package that is applicable not only to trade in agricultural products but to trade in general.

Resilience to Long-Term Demand and Supply Trends

Another question to be addressed in assessing trade reform proposals is how sustainable they are in the face of productivity improvements, possibly combined with slow growth in demand. To put it differently, will the suggested reform proposals make much of a difference given the natural evolution of all other factors that determine quantities and prices? To answer this question, an analysis has to distinguish between a reform proposal's ceteris paribus effects[32] on prices, quantities, and trade and its predicted actual effect. The first type of analysis would compare the state of the world in n years for situations both with and without the policy change. The second type would compare the policy's effects in n years, assuming all other factors were also at work during that time, with the current state of the world. The difference between these two views can be illustrated with the help of a simple graphic example (Figures 1 and 2).

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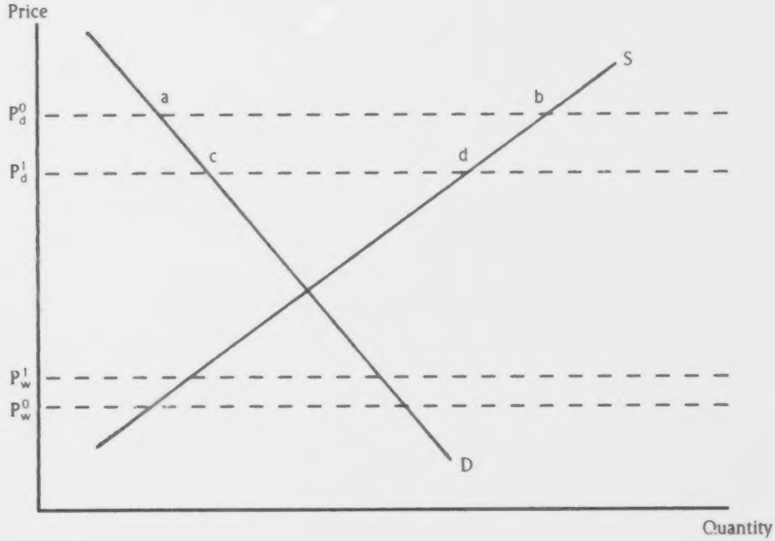
[31] As discussed in more detail in Chapter 5, comprehensive measures such as bound producer subsidy equivalents cannot totally eliminate avoidance activities that reduce imports.

Assume the reform proposal calls for a reduction of the NRP, as measured by $(P_d^0 - P_w^0)/P_w^0$ in Figure 1, of x percent over a period of n years. A typical analysis based on ceteris paribus principles would predict a reduction of excess supply in the import-protecting country from ab to cd. The resulting fall in subsidized exports causes the world price to increase from P_w^0 to P_w^1. Clearly, the nature of this exercise is such that it predicts what would happen if all other factors were held constant. No prediction is made for the actually occurring quantities or prices in n years. This is because the dynamic aspects shaping the actual long-run outcome, that is, the effects of changes in productivity and income, cancel out in this type of analysis. Hence, the prediction of a rise in P_w in Figure 1 implies only that the world price would be higher than without the trade reform, not that it will actually rise in the wake of trade reform, given that all other factors are also changing. This important point is illustrated in Figure 2. It is based on the assumption that, over a longer period, productivity rises by an amount sufficient to shift the domestic supply curve from S_0 to S_1. During the same time period, income increases so as to move domestic demand from D_0 to D_1. The shifts in demand and supply curves effect an increase in net exports[33] despite a reduction in nominal protection (the new

Figure 1—Predicted impact of trade reform on trade volume in n years, with everything else assumed constant



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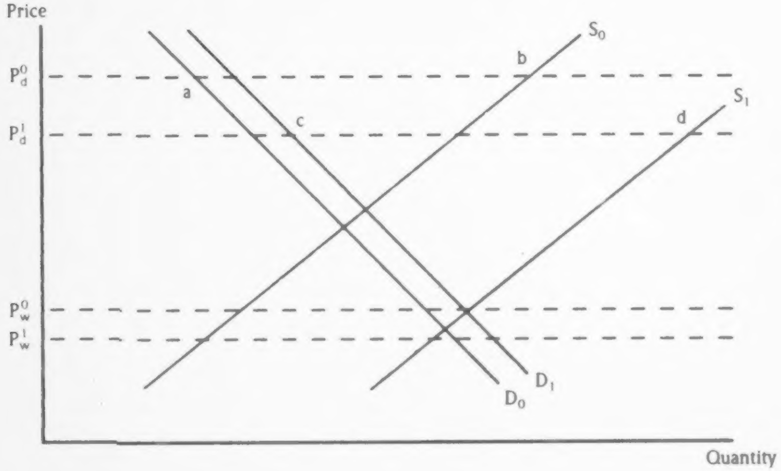
[32] The effects above and beyond the predicted changes resulting from innovations in all other determining factors of prices and quantities.

[33] Distance cd exceeds distance ab in Figure 2.

Figure 2—Predicted change in observable trade volume over n years, with trade reform as well as demand and supply growth



level of nominal protection is measured with reference to P_w). Assuming the development in other import-protecting countries is similar and productivity also increases in nonsubsidizing countries, the observed world price is going to decrease rather than increase compared with today's price. Naturally, the world price would show a larger decline in the absence of trade reform.

For the negotiations on trade reform, the predictions for actually observed changes, such as those in world price and market shares that emanate from an analysis along the lines of Figure 2, probably have an information content at least as important as ceteris paribus-type predictions, such as those associated with Figure 1. Besides, past experience with multilateral trade negotiations has shown that considerations relating to such factors as productivity have, at least implicitly, featured prominently in the negotiations. Otherwise, trade reform proposals such as freezing market shares or self-sufficiency levels could not be explained. The sole merit of these types of proposals lies in their ability to counteract possibly detrimental effects on export markets of either discretionary increases in protection or, more important, dynamic changes in demand and productivity in import-protecting countries. They are largely devoid of implications that can be captured with an analysis along the lines of Figure 1. A proper analysis of these reform proposals requires a framework like that of Figure 2.

Political-Economy Considerations

There are two levels at which political-economy considerations play an important role for the multilateral trade negotiations within the GATT: the level at which country representatives negotiate with each other, and the level at which domestic interest groups interact with each other and with the government in a given country. As the following discussion will show, these two levels are very much related. Also, the idea of fairness or evenhanded treatment plays a significant role at both levels.

Proposals for trade reform are likely to be uniformly acceptable among negotiating parties only if all signatories to the GATT are treated in an evenhanded manner. However, this cannot be taken to mean evenhandedness in every sector or even in every commodity group, especially if evenhandedness is defined as a balancing of requests and offers of trade concessions. If this is not clearly understood, the Uruguay Round may not succeed. This point becomes apparent in a consideration of, for example, the new active role in this trade round of developing countries such as the Group of 48 or the Cairns Group on agriculture. The vast majority of their requests for concessions are concentrated in two areas: agriculture and light industries such as textiles and clothing. Nearly all of their potential offers of concessions, however, are in other areas, the major examples being graduation of industrial goods, intellectual property rights, services, trade-related investment measures, and the Generalized System of Preferences. Hence, the balancing of offers and requests of trade concessions would seem to require a look beyond agriculture.[34] To put it more directly, developing countries could use concessions in property rights, services, and similar areas to force concessions from industrialized countries in, for example, agriculture and textiles.

Evenhanded treatment of countries implies another important point: aligning trade in agricultural products more closely with trade in manufactures. This involves, among other things, the elimination of special rules and waivers, such as the legality of export subsidies in agriculture as opposed to industry. Failure to do this may make it impossible to garner the support of countries that export mainly agricultural products, such as those countries loosely aligned in the Cairns Group. It would be hard to convince them of the merits of a partial trade reform that improves the trading environment only of countries that happen to export mainly industrial goods. (Clearly, the same argument applies for integration of the textiles and clothing complex into the GATT.)

If the latter point is accepted, then reform proposals specific to agriculture should be avoided. Otherwise the sector will again become subject to rules that are different from those for other trade, thereby treating agricultural exporters differently—most likely less favorably—than exporters of industrial goods. This is both unfair and inherently inconsistent with the GATT's underlying principle of nondiscrimination. In fact, it is just this type of differentiated treatment that has made the whole GATT system increasingly less credible.

The issue of evenhandedness of trade reform is also crucial in any effort to secure the support of special interest groups within a given country for trade reform and thereby to solve the problem of its domestic acceptability in the major trading countries. Domestic acceptability becomes a particularly tricky subject if it is simply measured by the amount of satisfaction or dissatisfaction within the farm lobby. Clearly, any trade reform package emanating from the Uruguay Round should be structured to avoid this. The following considerations would thus seem to be of vital importance.

First, most governments would probably favor the imposition of binding restrictions on protectionist measures (to roll back the influence of special interest groups) in agriculture as much as in other areas. As mentioned earlier, binding international restrictions serve as a kind of protective shield against the demands of special interest groups. If this view is correct, it would make a strong case for trade reform proposals that reduce the discretion of governments over changes in frontier barriers, such as variations of tariff rates, export subsidies, or restrictive state trading practices. As the farm lobby is known to be very powerful in many countries, with a strong representation in most agricultural ministries, too much decision leeway on the part of governments can keep them captives of internal politicking and hence impart a protectionist bias to their trade policy. Tighter restrictions on frontier barriers, through such means as mandatory binding of all tariffs and the closing of loopholes for protectionist activity, could make it possible, in principle, to move away from the present unfortunate situation in negotiations between the farm lobby and the government on changes in support or target prices. These negotiations increasingly resemble those for higher wages and benefits between the government and the unions representing its employees.

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[34] Support for this view can be found in Winters 1987. The opposite view is represented by McCalla (1987), who refers in this context to the unsuccessful attempts at negotiating compromises across sectors in previous multilateral trade negotiation rounds.

Second, domestic acceptability of a reform package is a function of the relative political influence of those groups of society that will gain from it and those that stand to lose, in the sense that they are subjected to adjustment costs. (Even groups that have to adjust are likely to gain, since, in the long run, adjustment costs fall solely on factors in fixed supply, mainly land.) As already discussed, consumers would gain the most from a trade reform directed toward more liberalization. But for reasons stated earlier, they are unlikely to form a strong lobbying group. Hence, in terms of making trade reform acceptable to a country, the size of consumers' potential welfare gains means little in getting a trade reform past the legislature. To counter the dominant influence of the farm lobby in countries such as the United States, the EC, and Japan, strong support in favor of trade reform has to come forth from groups that also stand to gain from trade liberalization in agriculture, yet are better organized and more vocal than consumers and hence have sufficient economic and political clout (see Duchêne, Szczepanik, and Legg 1985, 192). Recent quantitative evidence strongly suggests that industry and labor unions are such groups.[35] Both industry and labor outside of agriculture could expect to gain considerably from trade liberalization in agriculture. Estimates show, for example, that in the absence of the Common Agricultural Policy, employment in the EC-10 would rise on the order of 2-4 million people (Stoeckel and Breckling 1988). Results for Germany indicate that liberalization of agriculture would create 850,000 new jobs and raise gross domestic product by 3 percent and exports by even more. Net exports of investment goods by the mechanical engineering and electrical engineering industries, for example, are predicted to rise by 12 and 16 percent, respectively (Donges et al. 1988). Since similar findings are reached for other countries and industries, and on the basis of different model structures, they seem to be rather robust.

What still needs to be done, however, is to disseminate these results. Given the high degree of organization of industry and labor relative to consumers, this should not be an impossible task.[36] Once the basic facts about intersectoral linkages are fully understood, industry and other sectors in industrialized countries may become sufficiently motivated to stand up against agricultural protection and hence provide a viable countervailing power against the farm lobby. For governments this would provide a type of protective shield against overly zealous demands by the farm lobby similar to that of international obligations that are backed by the threat of financial compensation requirements or retaliation.

The countervailing power from industries and organized labor versus the farm lobby can be maximized when trade reform in agriculture, as well as other highly protective sectors such as textiles and clothing, is linked *in one package deal* with liberalization and hence with the prospect of trade expansion and higher profits in most of manufacturing and the services.[37]

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[35] This is the conclusion that can be drawn from the various analyses conducted for the Global Agricultural Trade Study, organized by the Centre for International Economics, Canberra, Australia. The research findings are summarized in Centre for International Economics 1988. Earlier studies on this topic are summarized in Winters 1987a.

[36] For example, the message seems already to have reached the influential Federation of German Industry, which recently came forth with some reform proposals of its own for agriculture. See Bundesverband der Deutschen Industrie 1987.

[37] See Baldwin 1987. In this context it has to be remembered that higher profits result not only from better market access in foreign markets, a prospect of interest primarily to exporters subject to significant trade barriers, but also from cost reductions due to cheaper intermediate inputs and more competitive factor prices in the wake of liberalization, a point of potential interest to all firms.

Such a single cross-sectoral reform package makes a successful completion of the Uruguay Round a lot more likely than an array of separate sectoral accords.

Apart from stimulating countervailing power against a resisting farm lobby and hence enhancing the acceptability of trade reform *within a given country*, such a cross-sectoral approach to trade reform also strengthens the prospects of balancing requests and offers for concessions *between countries*. This subject was discussed above in relation to developing countries trading more openly with industrialized countries in the areas of services and manufacturing in exchange for better market access in agriculture.

Up to the middle of 1988, the negotiations in the Uruguay Round have not paid much attention to the need for cross-sectoral agreements (see the discussion in Chapter 3). The idea of a package-deal negotiating strategy, however, has been brought up in the Negotiating Group on Agriculture—although not in the form of cross-*sectoral* deals as suggested above, but in the form of a sector-specific deal. The United States has made the package-deal idea part of its reform proposal for agricultural trade.

The aggregate approach proposed by the United States implies that the farm policies and programs affecting all agricultural commodities would be negotiated as one package. This certainly represents a step in the right direction, although whether an intrasectoral package-deal approach is sufficient may be questioned. It presupposes that one commodity group in favor of liberalization can countervail the political power of another one that is opposed. This idea may work in the United States, but what about Japan, for example? Is there any commodity group in Japanese agriculture that could provide enough countervailing power to effectively counteract the strong opposition of rice farmers to more open markets in agriculture? If there is no such group, then countervailing power can only come from outside of agriculture, assuming consumers cannot be counted on.

At any rate, the aggregate approach suggested by the United States certainly contrasts sharply with the procedure followed in previous multilateral trade negotiations that proceeded commodity by commodity. The latter approach appears to be still favored by the EC and is also clearly the one favored by the farm lobby. The representatives of farm interests are naturally disposed against cross-sectoral arrangements, a unifying principle for the trade negotiations, or even an aggregate negotiating approach limited to agriculture. These negotiating structures strengthen the countervailing power against either farm interests in general, as in the case of a cross-sectoral approach, or the interests of specific commodity groups within agriculture, as in the case of an aggregate approach to agriculture. This has become very clear, for example, from the response of certain U.S. commodity and farm group representatives to the U.S. proposal. The aggregate approach favored by the U.S. administration has been met with open resistance from some powerful commodity groups. Several groups considered themselves simply too special to be dealt with in a package deal. Others voiced their concern that U.S. negotiators would not focus on the best interests of a particular commodity group in such negotiations but would instead consider overall U.S. benefits in agriculture (see U.S. General Accounting Office 1988, 31-32).

In short, more emphasis on cross-sectoral negotiations and compromises appears to be critical to eventual achievement of the objectives stated in the Punta del Este Declaration. This requires, however, some changes in the procedural foundations of the Uruguay Round. First, the trade talks are in urgent need of a unifying principle, one that is applicable across all sectors. It could perceptively facilitate cross-sectoral compromises and, at the same time, force discipline on all negotiating groups. (See Nau 1987 for a similar proposition, and GATT Secretariat [illegible]a, 1.)

Second, government representatives at the highest echelon have to be more directly involved in the negotiations. Their involvement has helped significantly in getting the Uruguay Round started in Punta del Este. It is needed again midway through the Uruguay Round. Only at the highest government level is it possible to agree on the core of GATT reforms, that is, on a unifying principle or formula similar in spirit to the "across-the-board" tariff-reduction idea of the Tokyo Round. Experts from agriculture or other sectors cannot be counted on to achieve much progress on their own. They operate in a direct shooting line from their sectoral clientele. This special relationship makes it difficult for them to agree to more than marginal adjustments of the present system. Far-reaching changes that extend beyond the sector, and hence could generate compromises at a higher level, need the involvement of nonspecialists who are able and willing to see beyond narrow sectoral concerns.

5

THE THEORETICAL CONSEQUENCES OF CHANGING CERTAIN GATT PROVISIONS

Restricting the Use of Export Subsidies

In contrast to trade in manufactures, where export subsidies are explicitly prohibited by the GATT, export subsidies have become a frequently employed trade instrument in agriculture. Their main use has been to help industrialized countries such as the EC and the United States dispose of domestic production surpluses resulting from policies that support the domestic market price above its free market level.[38] The subsidies have enabled subsidizing countries to expand their exports at the expense of nonsubsidizing industrial countries such as Australasia and, above all, developing countries. Such is the case, for example, for beef and veal as well as sugar. A comparison of the average market shares for 1970-74 with those of 1980-84 shows that the OECD countries have expanded their export market share of beef and veal from 40.3 percent to 62.1 percent, while that of developing countries dropped from 52.1 percent to a mere 26.9 percent. The figures for sugar indicate an increase in market share for OECD countries from 17.0 percent to 28.5 percent and a drop from 73.8 percent to 67.4 percent for developing countries (Organisation for Economic Co-operation and Development 1987, 220, 226). Although some of the decline in market share for developing countries can probably be attributed to overvalued exchange rates and other similarly unfavorable domestic conditions for exporters (see Krueger, Schiff, and Valdés 1988), the larger part of the market share decline is certainly due to export subsidization combined with import protection in industrial countries.

The wide range of suggestions on how to solve the issue of export subsidies includes proposals on limiting their negative trade effects by fixing market shares, as well as proposals aimed at restricting their use. The latter proposals extend from a complete prohibition of subsidies to allowing them subject to certain restrictions.

Strengthening the Equitable Market Share Rule

Many, if not most, of the trade conflicts in agriculture have arisen because the equitable market share rule, which conditions the use of export subsidies for primary products, has turned out to be too general to be ascertained objectively. The evidence accumulated by GATT panels that addressed the issue of equitable market shares demonstrates that it has not been possible to find operationally meaningful criteria for what constitutes an equitable market share.[39] As a result, the market share rule has been rendered meaningless for all practical purposes. Taking this as the point of departure, redefining the equitable market share rule in the direction of improved operational effectiveness seems to be a natural suggestion for reform. The basic premise behind the proposal to refine rather than discard the idea of market sharing is the notion that focusing the negotiations on the outcome of government interventions as they relate to trade flows—in particular, changes in export market shares—can be more easily achieved than trying to define export subsidies and then to outlaw or otherwise restrain their use. Although this focus on the ultimate trade effect of government intervention in trade is very much in the spirit of the GATT, it remains to be seen whether this can be said also of the conceivable ways of implementing a refined market share rule.

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[38] Whereas the EC has long subsidized exports for numerous agricultural commodities, export subsidies by the United States have become more frequent only since the passage of the 1985 Farm Bill. Since then, exports of beef, dairy products, sugar, wheat, rice, corn (maize), and cotton have been directly or indirectly subsidized via the Export Enhancement Program, the Marketing Loan Program, deficiency payments covering all production rather than only domestic consumption, and various other devices. See Hathaway 1987.

[39] So far, four GATT panel decisions have involved the equitable market-share rule. In the Australia versus France dispute on French wheat flour exports of 1959, the GATT panel concluded that export subsidies had expanded France's market share to a more than equitable level. No conclusive decision was reached in the subsequent three cases—Australia versus the EC and Brazil versus the EC on EC sugar export subsidies in the late 1970s, and the United States versus the EC on EC wheat flour export subsidies in 1983.

Ways to make the market share rule more operational have been deliberated on in some detail by the Committee on Trade in Agriculture. The suggestions developed in these discussion rounds rely in one form or another on predetermining exports in numerically fixed form for the major commodities and exporters. Market sharing in the conventional sense would imply that an exporter's share in world exports would be limited to a particular percentage. An alternative proposal would fix the exports of a given country in a particular commodity to a fixed tonnage amount that is related to past export performance. For example, the export quota could be set equal to exports in the past year or to average annual exports in the past five-year period. In contrast to the conventional export market share idea, this method has three distinct advantages: the amount of uncertainty for nonsubsidizing exporters would be reduced; verification would be made easier both in terms of data requirements and of the time lag between the end of the trading year and the necessary review of the export performance; and, perhaps most important, taking advantage of world export growth would be reserved for nonsubsidizing countries, allowing them to capture at least some of the effect of their competitive advantage. To avoid the problem of legitimizing existing market shares acquired through unrestrained past subsidization, modifying the above approach by replacing actual historical market shares with negotiated ones could be considered.

On the positive side, market-sharing arrangements of the above type would clearly cause few definition or measurement problems. They are also fairly easily monitored, although unfortunately only after the fact in many cases. (For commodities that are exported fairly evenly over the course of a trading year, monitoring is possible before the end of the year.) A possible problem could develop, however, for those commodities for which nonsignatories of the GATT supply a major share of world exports, such as Cuba for sugar. Another advantage of fixed export market shares is their resilience to avoidance strategies on the part of exporters. Regardless of what form of government intervention is applied by a given country, its end result, the actual trade volumes, cannot be manipulated. (Exporters could, however, switch to higher-quality exports, which might infringe on the interests of other exporters.) In principle, fixed export quantities or shares are also resilient to long-run changes in supply and demand. Increased productivity of subsidizing countries, for example, would have no effect on other countries, yet would increase the financial burden on price-supporting governments. Productivity increases in nonsubsidizing countries would mean either higher government outlays or lower farm prices for farmers in subsidizing countries. In either case, there would be an incentive to lower price supports and hence subsidies.

Market-sharing agreements are similarly without problems from the political-economy perspective. They clearly cater to the interests of the farm lobby because they are likely to involve only marginal adjustments for farmers, not the establishment of a completely new and unfamiliar incentive structure, with possibly significant economic losses for fixed factors in the short and medium runs. For example, there would be no pressing need for the EC to abandon the principles of its Common Agricultural Policy. The system of variable levies and export subsidies could be left essentially intact, although the requirement to maintain export market shares at present or slightly reduced levels would force more discipline upon demands of farmers for increased support prices. Politically then, market sharing would seem to be very attractive. Such a proposal for agricultural trade reform would be almost guaranteed smooth sailing through the legislatures of subsidizing countries because domestic opposition to such a solution would be weak, at best. After all, consumers are unorganized and other industries or sectors that could gain from agricultural trade liberalization would be dealt with in separate arrangements, fully delinked from agriculture. Overall then, there appear to be several arguments strongly in favor of market-sharing agreements, or what is sometimes called "managed trade."

Market-sharing agreements can be criticized on two grounds. First, they do not have a successful track record. The experience with various commodity agreements for wheat, cocoa, and coffee suggests that they do not last very long. Usually they run into trouble over problems of long-run demand and supply effects. In theory, strong increases in productivity combined with stagnant world demand would call for internal adjustments in the form of lower production in subsidizing countries. In practice, however, production is often not curtailed, thus leading to declining world prices and ultimately to a breakdown of the commodity agreement itself. In other words, market-sharing arrangements can work quite smoothly in the face of strong demand growth, but they hardly ever survive the double blow of stagnant or diminishing demand and growing supply.

Second, market sharing in agriculture would strongly contradict two basic GATT principles: nondiscrimination and reliance on the price mechanism for trade restrictions. Countries that mainly export agricultural products would be put at a clear disadvantage compared with countries that mainly export manufactures. Only the former would be constrained in their exports, being able to make use of their comparative advantage only at the margin and starting from an artificially low base. Fixed export quantities would allow an efficient resource allocation, both within countries and among countries, only for that part of world trade that results from future demand growth, not for current levels of world trade. If demand growth is expected to be low, as is the case for numerous agricultural commodities, little export expansion is possible for efficient exporters unless the export share or export quantity granted to subsidizing countries is reduced over time.

Negotiating and then fixing export quantities or shares for a large number of countries and commodities years into the future is no small task. In all likelihood, this would involve arrangements outside the confines of the General Agreement and very similar in principle to the Multifiber Arrangement in textiles and clothing. This assumes that an arrangement could be reached at all. In this case, however, agriculture would have become the second area subject to managed trade. Such a development could severely weaken the GATT system and its credibility, not only in the eyes of nonsubsidizing countries but also in the eyes of sectors and industries that are still subject to GATT disciplines. Extending a system of managed trade to agriculture would confirm that export subsidies pay off after all in the sense that, eventually, the market share achieved this way will be vindicated by international agreement. It would also send a strong signal to the effect that hard lobbying is really all it takes to eventually receive special treatment, that is, to gain relief from the forces of international competition. Special conditions, which supposedly make agriculture a unique case and thereby justify this special treatment, can surely be claimed also by other industries and sectors.

Prohibiting Export Subsidies

Instead of developing further the existing rules on export subsidies in agriculture, a more drastic solution may be chosen—disallowing export subsidies altogether, with some well-defined exceptions. The rationale for this can be understood in light of the disappointing experience with the equitable market share rule discussed above and the largely ineffective attempt to "strengthen" the GATT rules on export subsidies through the introduction of the Subsidies

Code negotiated during the Tokyo Round. (Hufbauer and Erb [1984] provide a discussion of this code.)

Some Theoretical Preliminaries. Export subsidies affect the terms of trade of trading partners. In particular, they improve the terms of trade of importing countries. Consumers in importing countries experience a welfare gain. This is the reason that net importers of grains, among them many low-income developing countries, do not favor an end to all export subsidies. If all else remained the same, ending these subsidies would worsen the net importers' terms of trade. The ceteris paribus condition, however, is questionable. By raising the profitability of the subsidized product, export subsidies divert resources away from other uses, that is, from industry in the case of agricultural export subsidies. In short, agricultural export subsidies raise the world market price of industrial goods relative to agricultural goods. Hence an end to agricultural export subsidies is likely to lower the relative price of industrial goods. If industrial countries have a comparative advantage in industrial products relative to agricultural products and vice versa for many poor developing countries, a ban on agricultural export subsidies can therefore improve the allocation of resources without negatively affecting the terms of trade of developing countries, at least in the medium to long run.

For the export-subsidizing country, a general export subsidy is equivalent to a general import subsidy, barring any deviations from the conditions of long-run general equilibrium.[40] An export subsidy can therefore serve a useful purpose: it can compensate for import restrictions.[41] Applying this idea to the two broad sectors of agriculture and industry means that export subsidies on agricultural products could be used to compensate for the negative effects on domestic resource allocation of import restrictions for industrial goods. This argument for export subsidies may have some validity for developing countries. Many of them continue to protect import-competing industries heavily, thereby levying a hefty tax on agriculture (see Krueger, Schiff, and Valdés 1988). Yet export subsidies are seldom observed. One obvious reason is their high budgetary cost. But even if funds were plentiful, the removal of import protection is certainly the obvious best choice rather than an attempt to counteract one distortion with another. For industrial countries, export subsidies on agricultural products can be even less justified by import restrictions outside of agriculture. As discussed at some length in Chapter 3, agriculture is generally more protected than industry (there are some exceptions, such as Australia). Hence, industrial goods rather than agricultural products would have to be subsidized in most industrial countries.

In short, the theoretical reasons against a ban on export subsidies appear of little practical importance for either developing or industrial countries.

The Scope of a Prohibition on Subsidies. Before the potential trade effects of a prohibition of export subsidies can be analyzed, it is necessary to define the scope of such a subsidy ban. As the discussions of the Committee on Trade in Agriculture have made clear, this issue is in itself far from settled. Two basic approaches are seriously considered: defining export subsidies in a comprehensive way, and treating agricultural goods like nonprimary goods.

A comprehensive definition of export subsidies would include all indirect subsidies as long as they operate to increase agricultural exports. Included in such a comprehensive prohibition would be any form of price and income support to farmers, making avoidance behavior of governments difficult if not impossible, at least in theory. However, it is clear that it would be difficult to draw the line between subsidies that affect exports and those that do not, especially because a number of subsidies are well known to have a distinctly different effect in the long run as opposed to the short run. Subsidies for research and extension as well as infrastructure, for example, are in this category. Hence, if an all-encompassing definition of prohibited subsidies is applied, it may be wise to add an illustrative list of government assistance measures that are exempted from the subsidy ban. Such a list could include support payments with only indirect links to trade, such as deficiency payments on domestically consumed production or cash payments unrelated to production. A general prohibition of subsidies could thus be made more manageable, and the unwanted effect of preventing domestic agricultural policy reforms that are in the interest of world trade, such as a switch from market price support to income support, would be minimized.[42]

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[40] This is the essence of the well-known Lerner symmetry theorem. See Lerner 1936.

[41] Export subsidies increase domestic prices for exportables relative to importables. This is equivalent, in principle, to a decrease in import prices or a subsidy on importables.

A comprehensive definition of illegal export subsidies is less appealing because it would again give agriculture a special status, although with the policy on subsidies completely reversed from the lax rules that obtain currently. As the rules on subsidies would be more stringent in agriculture than in any other sector or industry, such a reform proposal seems unlikely to have a realistic chance in the legislatures of industrialized countries. Simply extending the prohibition of export subsidies on nonprimary goods contained in Article XVI:4 to agriculture seems to be the most appealing solution. (This would imply that the Subsidies Code be changed accordingly.) First, it would mark a move toward a more consistent GATT treaty. With agriculture losing its special status and trade reforms consequently being negotiated for all trade, possibilities of true progress in international trade relations could be opened up (see the discussion of political-economy considerations in Chapter 4). Second, surveillance and enforcement would be made easier compared with the first option. For countries that have signed the Subsidies Code, its more detailed provisions would be binding, including the illustrative list of prohibited export subsidies (see Appendix 2). For all other signatories of the General Agreement, Article XVI:4 would be relevant, linking export subsidies to the existence of a positive price difference between domestic price and export price. This latter definition of export subsidies will form the basis of the discussion in this and the following chapter.

The Trade Effect of Discontinuing Export Subsidies. To analyze the trade impact of a discontinuation of export subsidies, it will be assumed that they serve to dispose of domestic surpluses generated by a policy of import protection in combination with price guarantees to farmers. As already mentioned, this is likely to be the most important application of export subsidies in agriculture. A typical example is the Common Agricultural Policy of the EC for wheat and beef. Without a change in the system of market price support, a discontinuation of export subsidies would involve a policy choice between accumulating ever-growing stocks, destroying excess supplies, or shipping the excess overseas as food aid. All of these methods have in fact been used for one product or another by countries with surpluses, sometimes substituting for and sometimes accompanying subsidized exports. If it is recognized that none of these methods offer viable long-run solutions, the cause of the surpluses, that is, the method of market price support, has to be changed. It should come as no surprise that there is a multitude of options available to countries to react to a general ban on export subsidies, with each alternative having a potentially different trade effect. In trying to identify some likely reaction patterns, it is helpful to distinguish between behavioral adjustments working primarily on the demand side and those affecting mainly the supply side.

One solution to the excess supplies problem and one very much in the spirit of a free market approach would be to lower support prices and frontier barriers to a level where the domestic price coincides with the price that just clears the domestic market. In contrast to a pure demand- or supply-side policy, this approach would have both a negative production and a positive consumption effect, reinforcing each other in curbing excess supplies. The trade effect of such a change in domestic policy would operate only on the world export supply schedule—not on world import demand. Subsidized exports would be eliminated, thereby shifting the world export supply curve to the left and causing, ceteris paribus, an increase in world price. As the specified country would not turn into an importer, world import demand would be unchanged. Nonsubsidizing exporters would benefit not from better access to the country but from the fact that competition from subsidized exports in third markets would cease.

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[42] An interesting scheme of decoupled income payments was suggested in the Boschwitz-Boren Bill, which was considered for the 1985 U.S. Farm Bill but was ultimately defeated. It called for gradually declining "transition payments" to farmers, based on past acreage and yield, with high payments at the beginning to offset losses during the adjustment toward market-oriented farming. See Paarlberg 1987, 118-120.

To make a policy of lower protection levels socially acceptable, income transfers would be called for. To minimize unwanted production effects, transfers would have to be personalized, limited to the current generation of farmers, and not bound to specific production decisions of farmers. Payments under this scheme are simply intended to maintain income, leaving it to farmers to adjust production fully to market conditions. To take the stigma of welfare payments out of decoupling, payments could be linked to the idea of structural adjustment. Transfer payments could be made at one time or at a continually decreasing rate over time to make up for the loss in land values associated with an elimination of market price support policies or the need to move out of agriculture or both.

Decoupling is still likely to meet with resistance from the farm lobby because it has to be funded out of general tax revenue, thereby making farm policy highly visible and subject to annual budgetary scrutiny. From a trade perspective, this is obviously exactly what is intended, because for nonsubsidizing countries it ends the uncertainty associated with open-ended support programs by subsidizing exporters. In this context it may also be noted that farmers are not the only ones with a vested interest in the continuation of present policies. The industries upstream and downstream from agricultural production and basically the whole rural economy are to some extent benefiting from current farm support policies (see Koester and Nuppenau 1987). Hence, compensating farmers alone may not be sufficient to get a sweeping trade reform bill passed by the legislature. As discussed in Chapter 4, strong support in favor of trade reform may have to come from outside of agriculture.

A pure demand-side policy would try to solve the problem of excess supplies by stimulating domestic demand for the product in question. This could involve any combination of a variety of methods, such as selectively lowering consumption taxes on that good, its complements, or the products it enters as input; raising taxes on substitutes, in raw or processed form; subsidizing new demand niches;[43] and restricting import demand for substitute products or their complements, again in raw or processed form.

For the product in question, each of these pure demand-side policies results in a shift to the right of the domestic demand curve. Depending on the price elasticities of demand and supply, the supported market price prior to the policy shift could be maintained, making income transfers or deficiency payments unnecessary. In contrast to a policy response based on a reduction in protection levels, the degree of protection need not change. The trade effect would be the same in both cases, as long as the view is restricted to the product in question. However, the trade effect of the two policy responses may differ appreciably if the analysis is extended to include the other products, complements, and substitutes that are influenced. In particular, imports of the indirectly affected products would decline, either because of an increase in their import protection or because of government-induced changes in their relative prices.

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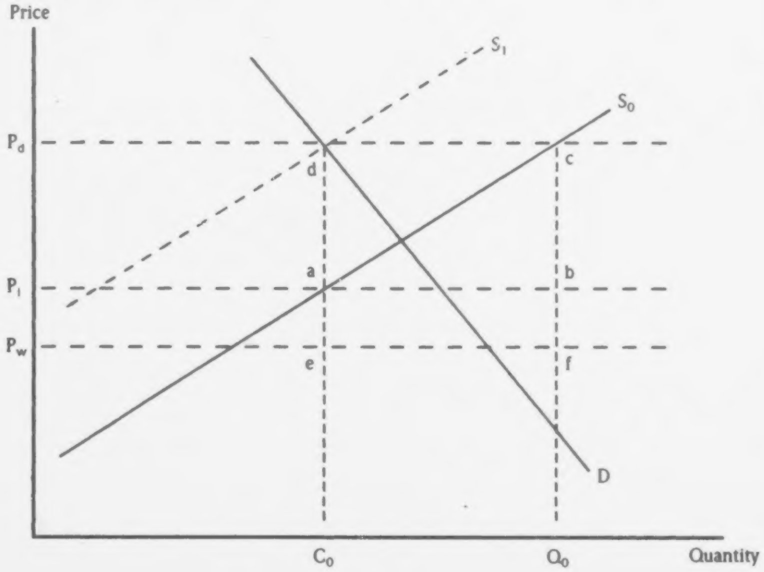
[43] An example would be to subsidize the conversion of "natural resources" such as cereals or sugar beets into a fuel substitute, or of milk into butter or cheese. Such a subsidy would be equivalent to an input subsidy on the end product, with the possible effect of increasing exports of the derivative, again at the expense of nonsubsidizing exporters. Hence, the excess-supply problem would simply be shifted to a different market.

Whether the rest of the world would be better off with or without such a policy response is unclear a priori. What is certain, however, is that the overall trade effect would be worse for pure demand-side policies than under a policy of reduced protection levels. It may also be noted that demand stimulation alone would probably not suffice to eliminate substantial excess supplies, for example, those experienced by the EC over the past decade in products such as beef and sugar. The reason is that domestic own-price or cross-price elasticities of demand are generally considered to be quite low for primary agricultural products.

Pure supply-side policies would attempt to curb production to eliminate excess supplies, leaving the nominal protection level constant. Input subsidies could be reduced for that purpose, tariffs could be raised on imported inputs, or production could be taxed. Either policy would shift the domestic supply curve up to the left, from S_0 to S_1 in Figure 3, assuming the implicit tax on producers equals distance ad. An implicit tax of that size would ensure that the domestic market clears without a reduction in the nominal protection level. The trade effects resemble those of a pure demand policy: subsidized exports cease, while imports remain zero. This is the partial equilibrium result. However, as in the case of pure demand-side policies, there may be unintended effects on related products. For example, restricting implicit taxation to product A may induce farmers to shift resources to product B. Even though the need for export subsidies is eliminated for product A, imports for product B may now be lower than before, thereby hurting the interests of countries exporting B. Hence, an implicit tax on isolated products may only shift, not eliminate, the problems caused by high domestic support prices and frontier barriers.

For domestic farmers, a pure supply-side policy based on implicit taxation is decidedly inferior to a pure demand-side policy. Their producer surplus, that is, the area between price line P_d

Figure 3—Pure supply-side policy



and the supply curve,[44] diminishes under implicit taxation, whereas it remains constant under a demand-side policy. Hence, closing the gap between supply and demand at support price P_d through a policy of implicit taxation appears politically difficult. Probably the only way to achieve it is by compensating farmers for their losses through cash payments and, at the same time, building up strong support for a change in agricultural policy outside of agriculture. As discussed in Chapter 4, creating such support requires, among other things, embedding agricultural policy reform within the context of a multilateral trade agreement that encompasses all trade and is balanced across sectors.

Acreage reduction is an alternative to implicit production taxes if export subsidies are prohibited but support prices cannot be reduced for political reasons. Acreage reduction programs are certainly favored by farmers. Such programs have a long tradition in the United States, but they also appear to be gaining popularity in the EC. In fact, the agricultural policy in the EC seems to be drifting in this direction even without a ban on subsidies, because acreage reduction or set-aside is seen as a way to reduce the budgetary costs of farm support.[45] Set-aside programs can operate in a number of ways. A direct incentive system as practiced in the United States from 1956 to 1958 under the name of Acreage Reserve Program, or one similar to the diversion program in effect since the 1960s, involves paying farmers a specified premium per acre taken out of production. (The set-aside program presented by the EC Commission in early 1988 also falls into this category.) The predominant acreage reduction scheme in the United States since the 1960s works instead via indirect incentives. Rather than paying farmers for each acre taken out of production, the government subsidizes the remaining acreage used for continued production with deficiency payments. The deficiency system will be addressed later. For the moment, the discussion will be restricted to the direct incentive system.

Figure 3 helps to explain the basic idea behind the direct incentive form of set-aside programs. A premium equal to $(P_d - P_i)$ per production unit is paid to farmers in order to reduce domestic production from Q_0 to C_0 and hence eliminate the need for subsidized exports. Compared with the case of export subsidies in the amount of efcd, producers gain from the acreage reduction scheme. They are better off by triangle abc. The costs to the treasury are lower by rectangle efba. There are some practical problems, however. In reality, the premium is paid not for production units forgone, as assumed above, but per land unit taken out of production. Reducing acreage, though, does not necessarily imply that production diminishes by the intended amount $(Q_0 - C_0)$. At least this has been the experience in the United States with acreage reduction programs. The simple reason is that farmers intensify production efforts on the remaining land. What happens to the land taken out of production also plays an important role. If it can be used to produce other agricultural commodities, acreage reduction for one product may simply lead to more exports or lower imports in another product. For all commodities taken together, then, there may be little gain to exporters of nonsubsidizing countries.

What remains to be discussed is policy responses that combine elements of a supply-side policy with changes in the nominal protection level. One such policy response would consist of substantially reducing or even eliminating import protection and at the same time raising input or production subsidies sufficiently. Figure 4 illustrates such a case. The level of protection is lowered so that the domestic price drops from P_d^0 to P_d^1. As partial compensation for farmers, a unit production subsidy of size ab is put in place, thereby shifting the domestic

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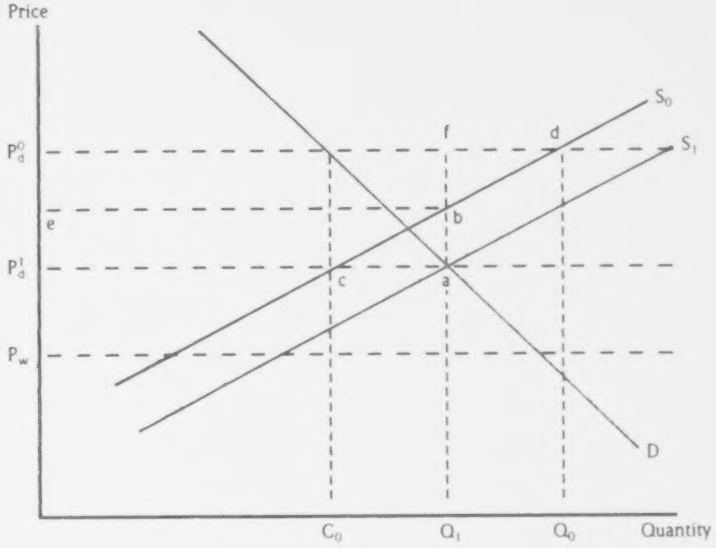
[44] S_0 is relevant before and S_1 after implicit taxes are imposed.

[45] See *Agra Europe*, January 22, 1988, P/1 - P/3. The EC Commission seems to endorse this shift. For example, it has drawn up an elaborate acreage reduction plan for cereals. See *Agra Europe*, January 15, 1988, P/1, for a summary of the plan's provisions.

Figure 4—Partial replacement of import protection with domestic subsidies

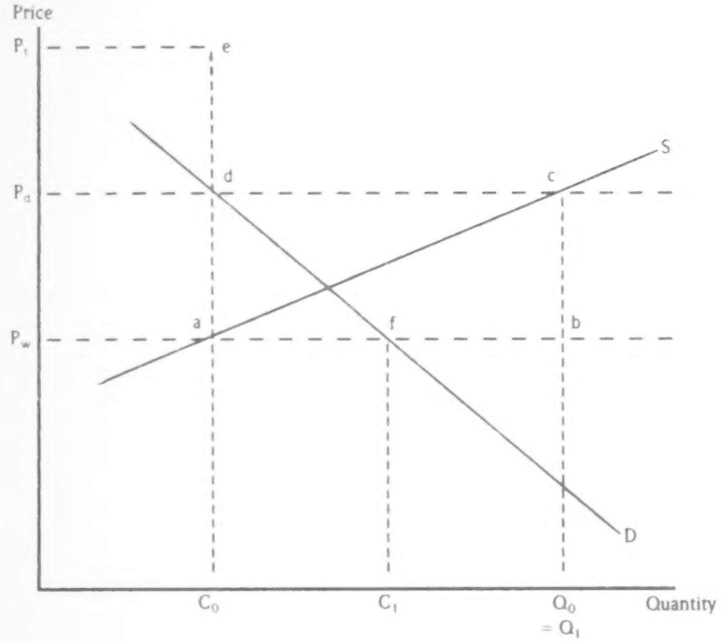


supply curve to the right. Domestic production declines from Q_0 to Q_1, and consumption rises from C_0 to Q_1.

The trade effect of such a policy parallels that resulting from a pure demand or supply policy: imports would remain at zero, and exports would decline to zero. The switch from a trade regime characterized by high protection and export subsidies to one of low protection and production subsidies affects the rest of the world only via a change in world export supply. Less will be exported at subsidized rates but no more will be imported. Whether such a policy response is found acceptable by farmers depends on the size of the subsidy relative to the reduction in nominal protection and the relevant demand and supply parameters. For example, a subsidy of size ab is clearly insufficient to compensate farmers fully for the reduction in market price support from P_d^0 to P_d^1. (As S_0 is linear, area abc equals area bdf, so farmers lose area bfP_d^0e as a result of this policy change.) Consumers clearly benefit because they face lower prices. Government expenditures are now in the form of production subsidies rather than export subsidies. Whether expenditures rise or fall is not clear a priori.

Instead of substituting domestic subsidies for export subsidies, a two-price system could be introduced. The essence of a two-price system can be explained by reference to Figure 5. Before the elimination of export subsidies, exports equal quantity (Q_0 - C_0) at domestic support price P_d. The domestic price is maintained at level P_d through sufficiently stringent import restrictions (in the case depicted, this could be a zero import quota or a prohibitive tariff). The export subsidy amounts to area abcd. Switching to a two-price system has somewhat different implications, depending on the way it is administered. Governments have two basic choices. Under the first option, the government restricts domestic sales to C_0 to keep the domestic price from falling below P_d. The size of the per-unit deficiency payment to farmers (P_t - P_d) is then determined by domestic supply conditions. Under the second option, the government fixes instead the per-unit deficiency payment (P_d - P_w) and farmers respond by setting the quantity produced (Q_1).

Figure 5—Two-price system

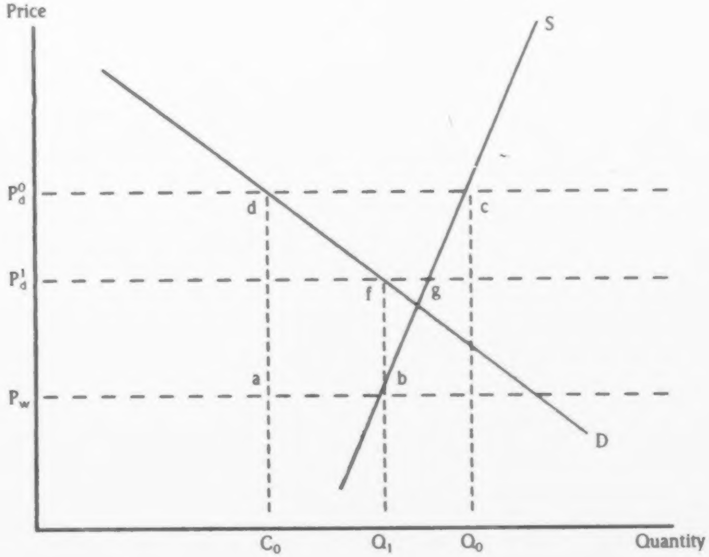


Some comments are in order on the first option. To restrict domestic sales to C_0 the government can intervene in a number of ways. One of the more efficient ways would be to distribute marketing certificates to farmers based on their production levels in some base period. Making these certificates freely tradable and tying their ownership to the deficiency payments would avoid production distortions characteristic of such schemes as equal percentage production cutbacks for all farmers or the U.S. version of deficiency payments (see Hathaway 1987). In particular, to be eligible for deficiency payments, inefficient farmers would not be required to continue producing, and efficient farmers would not have to idle productive land. Under the scheme, farmers would be free to produce as much for export as they want. The point is, though, that they face the world market price for any production beyond C_0. For all units up to C_0, farmers receive as deficiency payment the difference between the market-clearing price P_d and some target price P_t. Price P_t has to be sufficiently above P_d to compensate farmers for the loss in producer surplus identified by area acd. Per-unit deficiency payments would have to be at least equal to distance $P_t - P_d$. Productivity increases in combination with slow demand growth would enlarge area acd in Figure 5, thereby raising the price P_t needed to compensate farmers. Compared with the system based on export subsidies that this version of a two-price system replaces, government expenditures diminish because the deficiency payments covering the loss in producer surplus (de$P_t P_d$) are lower than the former export refunds (abcd). The funds the government saves are equal to some share of the resource cost of the former level of production. (The switch to a two-price system is saving the government revenue equal to area abc in Figure 5.) Consumers are unaffected by the switch in support policies. They continue to pay price P_d and thus continue to bear much of the cost of farm support.

Under the second option for deficiency payments, it is assumed that all frontier barriers to trade are dismantled. Hence consumers face the world price P_w and consume quantity C_1. In contrast to the first case, they do not share in the costs of farm support. The burden is fully shifted to taxpayers. As a result, government expenditures exceed those realized under the first option discussed above by the implicit tax paid by consumers under that scheme (adP_dP_w). Another crucial difference is that deficiency payments are not limited to a particular quantity as they are under the first option. Rather they are paid on all production units, regardless of whether part of that production is exported or not.

The trade implications of the two types of deficiency payment schemes are different. Under the first option, imports remain below their free trade level for countries that would be importers under free trade ("natural" importers).[46] For example, in Figure 5, which depicts the case of a natural importer, free trade imports equal distance af. Under the two-price system no imports occur. Hence, for imports, there is no change compared with the situation that obtained under a system of price support cum export subsidies. In the case depicted in Figure 5 there would also be no exports under the deficiency payment scheme. It would simply not pay for farmers to produce in excess of C_0 because their production costs are in excess of the prevailing world price for units beyond C_0. This result is independent of the size of the deficiency payment per unit as long as deficiency payments are paid only on the domestically consumed quantity. Hence, for exports, the first option of the deficiency payment scheme appears to compare favorably with the price support cum export subsidy regime for which exports were of size $Q_0 - C_0$. However, there is a caveat. There could be cases for which exports would not cease under this option. Such a case is depicted in Figure 6.

Figure 6—Two-price system with implicit export subsidization



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[46] Exports are lowered to their free-trade level for "natural" exporters, that is, countries that would export under free trade.

At price P_d^0, consumption equals C_0 in Figure 6. In analogy to Figure 5, C_0 is the quantity supported by deficiency payments. (The deficiency payments for the case depicted in Figure 6 would amount to area abcd.) In contrast to Figure 5, though, total production (Q_1) will now exceed the quantity that receives deficiency payments (C_0). The difference ($Q_1 - C_0$) can be produced profitably at world price P_w and exported without the help of explicit export subsidies.[47] Although exports are lower than under the price support cum export subsidy regime, thereby providing third-country exporters with somewhat better trading opportunities, there is still the peculiar situation that a natural importer is exporting, and this without any apparent explicit export subsidies. Exports are possible, however, only because the government is committed to deficiency payments that are related to a very high level of protection relative to the particular shapes of the domestic demand and supply curves. Deficiency payments serve the function of an indirect export subsidy in this case. The indirect subsidization of exports would not occur if the government were committed to deficiency payments only relative to a lower level of protection than indicated by P_d^0. In particular, exports would cease for a protection level corresponding to price P_d^1 or below and matching deficiency payments equal to area bgf or less. To sum up, the first option of implementing a deficiency payment scheme does not prevent countries that are natural importers from continuing to export the protected commodity in all possible cases. Indirectly subsidized exports can be prevented only if import protection is reduced at the same time that deficiency payments are limited to domestic consumption. The latter action alone is not sufficient to prevent indirect export subsidies.

Under the second option for deficiency payments, import protection is eliminated. Hence the type of indirect export subsidization described above cannot occur. However, there is still the possibility of indirect export subsidies. They can occur because the deficiency payments are not limited to domestic consumption but apply to all production. As per-unit deficiency payments ($P_d - P_w$) are granted for quantities beyond C_0, domestic producers face an effective price of P_d for any quantity they choose to produce (Figure 5).[48] Accordingly, they extend production to Q_1. As domestic consumption is considerably lower, at C_1, the difference, that is distance $Q_1 - C_1$, will be exported. Over time, as productivity increases and the supply curve shifts to the right at a more rapid rate than the demand curve, exports will even expand. In short, even in the absence of import protection, deficiency payments can have a trade effect that is very similar to the one that obtains in a system based on border protection and export subsidies. This can occur when fairly high deficiency payments are provided for all units of production, regardless of whether they are exported or not. This is basically what characterizes the U.S. deficiency payment system for grains, although its details are somewhat more complex. For instance, U.S. farmers receive deficiency payments only if they agree to restrict their acreage. This means that total production would be at a level below Q_1 in Figure 5. Also, total deficiency payments per farm are generally restricted. Finally, for most grains, Figure 5 would have to be changed somewhat to provide a more realistic description of the domestic U.S. market. In particular, the world price (P_w) would have to be set equal to the price level marked as P_d in order to depict the case of a natural or efficient exporter.

To sum up, a ban on export subsidies could be expected to have the following benefits. (The main objections to a ban on export subsidies were discussed under "Some Theoretical Preliminaries" earlier in this chapter.) Efficient exporters, that is, countries that would be net exporters under a free trade regime, would face less competition in their export markets from directly subsidized exports. Hence they would not have to support agriculture as much anymore to counteract foreign subsidies, thereby freeing resources for other purposes. For a given world demand curve, the world supply curve would move to the left, thereby raising world price. Efficient exporters would benefit from the resulting increase in both world price and export quantity, although not to the extent that would be expected under a free trade regime.

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[47] Clearly, farmers will export only if the government can prevent them from selling $Q_1 - C_0$ in the domestic market, in which case the domestic market price would drop to P_d^1. Government enforcement is likely to be possible if the commodity has to go through a particular processing or marketing channel. This is the case, for example, with sugar.

[48] Distance ($P_d - P_w$) equals distance ($P_t - P_d$).

Avoidance behavior, however, is still possible if export subsidies are prohibited. If pure demand-side or supply-side policies are substituted for export subsidies, without any reduction in market support prices, nonsubsidizing exporters may experience worse market conditions for products connected by either demand or supply cross-effects to those formerly subject to export subsidies. Exports of those products may drop and their world price may fall because countries that formerly imported these products on a large scale now import less or even export. Unbound tariff levels may have gone up, or voluntary export restraints may have been introduced in addition.

Unwanted trade effects may also result in the case where a deficiency payment system is substituted for export subsidies. If the deficiency payments per unit are relatively high and are provided for all production units, they may end up subsidizing exports indirectly, even if there are no import restrictions in effect. If there are import restrictions, deficiency payments may subsidize exports in an indirect way even if they are limited to the part of production that is consumed domestically. In the case of a natural importer, these indirect export subsidies are easily checked. All that needs to be monitored is the trade balance of the product in question. Evidence of any appreciable exports would signal that the ban on export subsidies, that is, indirect export subsidies, had been violated. For a competitive exporter that maintains no import restrictions, it is much more difficult to prove the existence of indirect export subsidies, especially if the exporter has a dominant influence on world price (this is typical of the United States in cereals). A pragmatic way to minimize these difficulties is to establish (for example, in the Subsidies Code) that deficiency payments shall under no circumstance be allowed on production not consumed domestically.

Policy responses along the lines of two-price systems are favored by many economists (see, for example, Paarlberg and Sharples 1984; Hathaway 1987). But as these systems generally involve the establishment of production quotas for farmers, some economists doubt their usefulness for countries other than the United States that do not have a tradition of such quotas (Henze 1985; Bergmann 1986). A system of production quotas makes considerable demands on the availability of statistical data at the farm level, and the more small-scale farming dominates agricultural production, the larger are administrative costs. These two points seem to be of some importance for the EC. (A discussion of the problems of applying acreage reduction schemes to European agriculture is given in Henze 1985, 332-333.) However, their importance should not be overstated; if there were indeed insuperable administrative difficulties, it is unlikely that the EC Commission would have come out with a detailed plan on acreage reduction.

Finally, some comments are required on the political-economy problems of a reform proposal that prohibits export subsidies. In all likelihood it would meet with some resistance, in particular from the EC, which is by far the main user of export subsidies.[49] After all, export subsidies are a central part of the EC's Common Agricultural Policy as it has evolved. But although their removal would require the restructuring of a number of commodity support programs, there may be some hope that the EC could agree to this, assuming it would get something in return, either inside or outside of agriculture. (The issue of compensation is discussed in Chapter 6.)

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[49] Adjustments would also be required by some Nordic countries, Austria, and Japan. Details on protection methods by commodity are supplied in Organisation for Economic Co-operation and Development 1987.

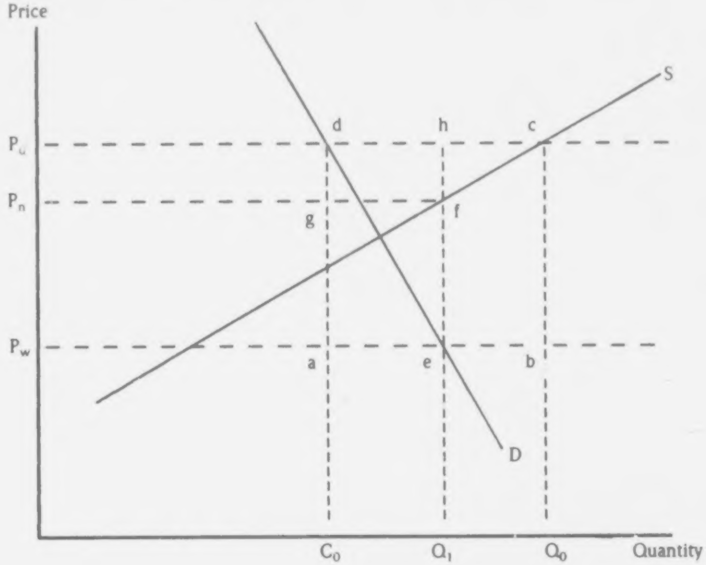
This guarded optimism stems from the EC's apparent leaning toward a system of acreage control. As shown in some detail above, however, acreage reduction can serve, in principle, as a substitute for export subsidies.

There is somewhat less need for the United States to adjust in the event of an export subsidy ban because export subsidies, although used more frequently since the 1985 Farm Act, are not central to most U.S. agricultural support programs. However, the U.S. system of deficiency payments for grains, for example, whereby payments extend to all production, would be in need of thorough reworking. Countries such as Japan or the Nordic countries, which operate highly restrictive import systems for much of agriculture but are not exporting, would of course not be required to adjust their farm support programs if export subsidies were prohibited for agricultural products. That is obviously why they have expressed essentially no objections to an export subsidy ban. (See the discussion in Chapter 3 of the reform proposals tabled by Japan and the Nordic countries at the Geneva talks in 1987.) Yet if the current disarray in agricultural trade is viewed as a result of import protection as much as of export subsidies, then a comprehensive reform proposal would have to encompass more than just a ban on export subsidies.

Allowing Only Producer-Financed Export Subsidies

In its deliberations the Committee on Trade in Agriculture has apparently come to the conclusion that export subsidies could be permitted in the GATT system as long as they are financed by producers themselves rather than being paid for by the taxpayer. The idea behind these Producer-Financed Export Subsidies (PFES) can be understood best by referring to Figure 7. As depicted, the PFES scheme applies to countries that, although they are natural importers, are currently exporting the commodity in question. As the domestic market price (P_d) is supported at a level far in excess of the world price (P_w), these exports (Q_0 - C_0) require export

Figure 7—Producer-financed export subsidies



subsidies equal to rectangle abcd in value terms. To make producers pay for the export subsidy, an ad valorem tax of $(P_d/P_n) - 1$ is levied on them. As the tax reduces the net price received by producers from P_d to P_n, they will cut production from Q_0 to Q_1. Consumers continue to pay price P_d, the official support price. (Note that PFES is at its heart also a two-price system, with a high price paid by consumers and a lower price received by farmers.) As a consequence of introducing PFES, the domestic surplus and, consequently, exports drop from $(Q_0 - C_0)$ to $(Q_1 - C_0)$. The amount of the required export subsidy falls from abcd to aehd. The tax revenue collected from producers amounts to rectangle $P_n fhP_d$. In equilibrium, it just suffices to cover export subsidies.

Compared with a ban on export subsidies, PFES results in a rather small trade effect. Exports diminish only marginally with PFES, whereas they would completely cease for a natural importer if export subsidies were banned. Consequently, any effect on world export supply and world price is going to be small. (See Valdés and Zietz 1987 for some numerical calculations of the effect of PFES for the case of sugar.) For a given supply curve, the larger the price elasticity of domestic demand, the more favorable the trade effect of PFES.[50] PFES has absolutely no trade effect if domestic production is unresponsive to price changes, that is, when supply curve S in Figure 7 is vertical. In this case, PFES is simply borne by farmers without inducing a change in behavior. Disregarding this special case, the main advantage of PFES lies in the link it establishes between fluctuations in world market price and domestic production decisions, even if a system of variable levies is used to support the domestic market price at level P_d in Figure 7. This link has two positive trade effects. First, it moderates the effect on the volume of subsidized exports of both an increase in the domestic support price relative to the world price and an increase in productivity. Thereby it removes some of the uncertainty for nonsubsidizing exporters that is associated with government-financed, open-ended export subsidies. Second, PFES would diminish the adverse effect of a variable-levy system on world market instability.

The disadvantages of PFES can be summarized as follows. If implemented alone, PFES could never fully eliminate, only moderate, the possibility of subsidizing countries' raising their export volume. The EC's experience with a related system of producer levies demonstrates that subsidized exports could very well increase. (See Hubbard 1986 for a discussion of the coresponsibility levy as implemented in the EC.) It is important to point out in this context, however, that the EC's coresponsibility levies are not fully equivalent to PFES as illustrated in Figure 7. Not only are the levies not large enough to finance all export subsidies, but they are also established along with the domestic support price. Both differences operate to remove some vital functions of the PFES as intended, for example, by the Committee on Trade in Agriculture. Nevertheless, the EC's experience has shown that the introduction of the coresponsibility levies caused the farm lobby to exert great pressure on policymakers to also raise the domestic support price. This effectively kept the net price received by producers constant at its pretax level, thereby shifting the tax to consumers. (See Tangermann 1986 for a more detailed discussion and Tangermann 1984, 159-168.) Not surprisingly, consumption contracted further and the pressure to export increased rather than diminished.

PFES may also be objected to because it favors farmers of countries with a relatively small export share, for example, the EC as compared with Australasia. Having a small export share means that the tax per unit of production could be rather small, thereby causing little income loss to farmers and weakening the link between world market and domestic production decisions. A tax of negligible size also results in a small reduction in subsidized exports. Hence the trade effect of PFES would be small in countries with a large domestic consumption base and vice versa (see Hathaway 1987). For this reason, PFES may not be acceptable to nonsubsidizing exporters on equity grounds. However, the same reasoning, that is, the prospect of no fundamental change in trade flows, strongly favors PFES in terms of its political acceptability by the farm lobbies of populous countries such as the EC.

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[50] In general, the larger the trade effect, the larger is the weighted sum of the elasticities of demand and supply.

There is also a question of the extent to which PFES fits into the legal framework of the General Agreement. After all, PFES implies that the export price is below the price paid by domestic consumers. According to Article VI:1 of the General Agreement, this constitutes a case of dumping if the exports cause or threaten material injury to another country's producers. Hence, if one attaches some value to the legal consistency of the General Agreement, PFES does not appear worth further consideration. Rather than eliminating the special treatment of agricultural export subsidies, PFES would simply replace one special exception with another, although with one that is somewhat less objectionable from an economic standpoint.

In principle, PFES can moderate the negative trade effects on nonsubsidizing exporters of export subsidies by natural importers. In contrast to straight export subsidies, PFES is broadly consistent with the GATT's main principles as discussed in Chapter 4. It does not introduce discrimination among trading partners and, perhaps most important, it reactivates the price mechanism for protecting countries by forcing them, at least in theory, to vary the producer price in tandem with the world price. PFES, however, will not eliminate export competition from natural importers, nor will it turn them into actual importers. In other words, PFES in itself will not solve the problem of export subsidies. If a reversal of trade flows is desired, something has to be done to lower the level of domestic market price support from the prohibitive level that is at the root of export subsidies.

Containing Quantitative Import Restrictions

Minimum-Access Guarantees

As a complement to putting more disciplines on the behavior of agricultural exporters, either in the form of a ban on subsidized exports or by limiting them to PFES, import-protecting countries could also be made subject to firmer disciplines. Article VI:2(c) of the General Agreement currently gives countries the option to impose quotas on the importation of agricultural products to pursue certain domestic policy objectives (see Chapter 3 for more details). Import quotas are supposed to be accompanied by equivalent restraints on domestic production so that they will not result in a market share for imports that is lower than the one that could have been expected in the absence of import quotas. The idea of this provision is to safeguard traditional import shares and thereby ensure continued market access for exporters.[51]

The Committee on Trade in Agriculture has spent considerable time discussing ways to broaden this market-access provision of Article XI. Two ideas for an extension seem to have received the most support. The first would imply that the minimum-access rule of Article XI applies not only when a country imposes a quota but also when imports are restricted in any form other than through the bound tariffs written into a country's trade concessions. This would include, among other things, restrictions such as voluntary export restraints or a rise in the domestic support price. (Note that the minimum-access requirement would apply equally to all import-protecting countries regardless of whether they are currently importers or subsidizing exporters.) The second amendment of Article XI would require countries maintaining import restrictions other than bound tariffs to allow imports to reach a market share of at least X percent, regardless of the market share of imports in the recent past. This provision would add a new dimension to the minimum-access idea.

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[51] Note that Article XI:2(c) does not guarantee the market share of a particular exporter—only that of all exporters. The provisions of Article XIII:2-4 on the nondiscriminatory administration of quantitative restrictions apply in this case.

The minimum-access clause in its current form only safeguards a historical market share against rising levels of import protection or productivity changes over time, as discussed in Chapter 4. If the market share of imports happens to be close to or equal to zero because of historically very tight import restrictions,[52] the minimum-access guarantee has no economic consequences. It cannot induce a change in policy. Adding an X percent provision to the current minimum-access rule would, by contrast, require a policy response by heavily protecting countries. It would force them to open up their protected markets at least to the extent that imports reach X percent.

The X percent rule could be implemented by defining minimum access either as a percentage of domestic consumption or as a percentage of domestic production. The former will have a greater trade effect, that is, will shift the world demand curve further to the right, if import-protecting countries are supporting their market price at below the self-sufficiency level and imports have not entirely ceased.[53] For countries that support the market price above this level and hence probably use export subsidies to dispose of their domestic surplus,[54] the trade effect will clearly be larger if minimum access is defined in terms of domestic production. It follows that, under the latter definition, the trade effect of the X percent rule increases whenever the support price is raised, whereas it would decrease if minimum-access requirements were expressed in terms of domestic consumption. Therefore, expressing the X percent rule in terms of domestic production is likely to provide a better disincentive to raising domestic support prices and hence protection. This definition will be assumed for the remainder of this section.

Four cases are analyzed to illustrate, in a comparative static framework, the trade effect of adding an X percent provision to the minimum-access rule currently in force. The four cases correspond to parts (a) to (d) of Figure 8. Figure 8(a) pictures domestic demand and supply curves for a commodity subject to a relatively low level of protection, as indicated by the percentage difference between domestic price P_d and world price P_w. Prior to minimum access, imports equal $C_0 - Q_0$. An X percent minimum-access requirement shifts the gross supply curve, that is, the horizontal sum of domestic production and minimum-access imports, from S to S_g. At price P_d^0, minimum-access imports equal distance ab, less than actual imports. Hence for case (a) the X percent provision has no trade effect. The world price remains unchanged.

Figure 8(b) depicts a case where minimum-access imports at support price P_d^0, distance ab, exceed actual imports at that price, $C_0 - Q_0$. Without a change in the support price, minimum-access imports turn the market from one characterized by excess demand into one characterized by excess supply. In order to identify the trade effects of an X percent provision in this case, some assumptions are required on the set of policies that would be allowed under a reformed GATT treaty and that are consistent with the country's domestic policy objectives. Regarding the latter, it will be assumed that continuous stock accumulation is out of the question, as is the destruction of excess supplies. Under these assumptions, the discussion of export subsidies in the previous section applies in full. If export subsidies are not banned, domestic surplus

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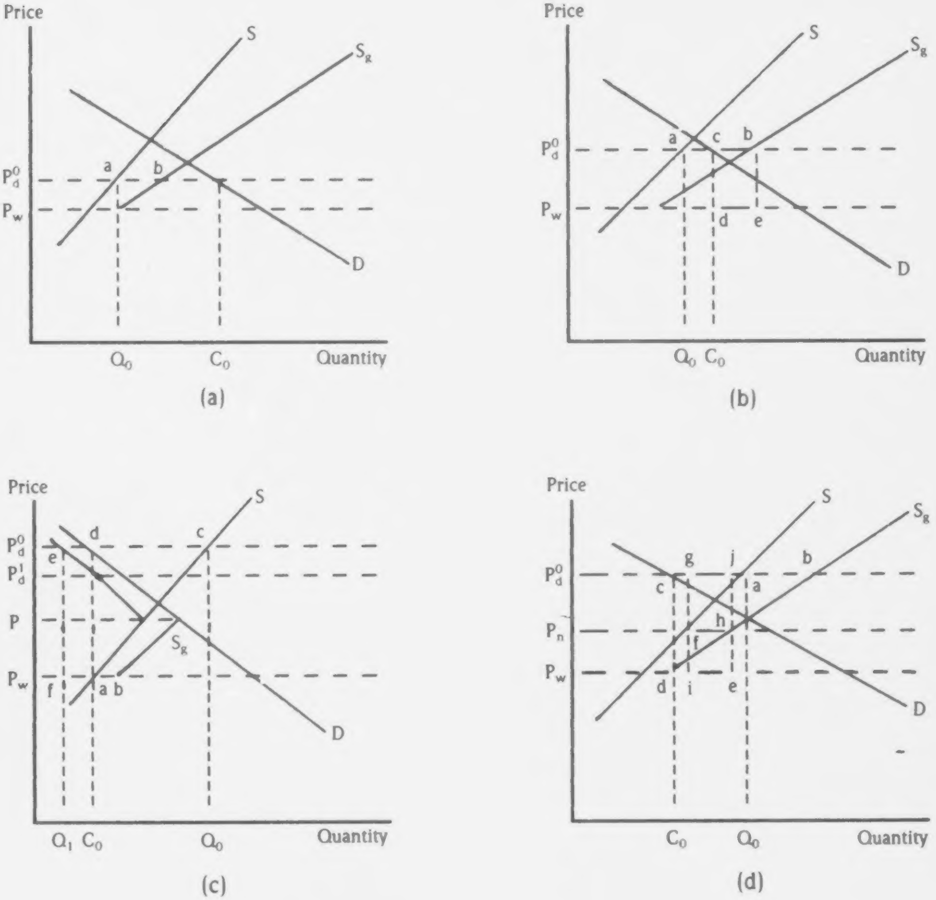
[52] Examples are the highly restrictive state trading practices Japan maintains for grains and the EC system of variable levies combined with export subsidies for wheat, beef, sugar, and other commodities.

[53] This description fits Japan for most agricultural products.

[54] The EC fits this description for a number of agricultural products, for example, beef.

Figure 8—Minimum-access guarantees under alternative economic conditions



bc could be exported, thereby avoiding any domestic adjustment and undoing any trade effect of the minimum-access imports. If protection is by tariffs or variable levies and minimum-access imports are not exempt, export subsidies could be fully financed out of tariff revenue. If import quotas or voluntary export restraints are used to raise the domestic price to P_d^0, the reexport would require government funds equal to rectangle bcde.

If it is assumed that export subsidies are prohibited, expansionary demand or contractionary supply policies could be adopted to clear the market at price P_d^0, that is, without a change in the level of protection. Either policy would cause minimum-access imports to have a positive effect on world demand, leading to an increase in world price. (In order to simplify the diagram, world price changes are not identified in Figure 8.) However, this applies only to the good in question. As explained in the section on export subsidies, it may well be that certain demand or supply policies have a negative trade impact on other goods, thereby partially canceling out the positive trade effect for the good examined. As an alternative to demand- or supply-side policies, the level of protection could be reduced sufficiently to clear the market. Minimum-access imports would be lower as a result because of reduced domestic production, causing a somewhat lower trade effect compared with policies that act on domestic demand or supply. From a general equilibrium perspective, however, such a policy response would have the advantage of reducing negative trade repercussions on other goods.

Figure 8(c) demonstrates the trade effects that result when minimum-access import requirements of X percent are combined with a two-price system. The S_g curve identifying gross supply, the sum of domestic production and minimum imports, takes on a somewhat different shape in this case. For protection levels corresponding to prices below P, S_g is identical to the curves shown in the other parts of Figure 8. Deficiency payments are based on the domestic production forthcoming at those prices. Minimum-access imports are less than or equal to the difference between domestic demand and production. The situation resembles that depicted in Figure 8(a). For higher levels of protection, for which the sum of domestic production and minimum-access imports exceeds domestic consumption, a two-price system would limit deficiency payments to a quantity equal to domestic consumption minus minimum imports. The quantity receiving deficiency payments diminishes with rising protection levels. In the case depicted in Figure 8(c), production reaches a maximum at domestic support price P. It falls for higher levels of the support price and reaches a minimum at price P_d^1.[55] This implies that minimum imports will never be smaller than indicated by distance ab. For domestic support prices between P_w and P_d^1, minimum-access imports will be larger than ab, and for support prices above P_d^1, minimum imports will be exactly equal to distance ab (=ed).

To analyze the trade effects of superimposing an X percent provision on a two-price system, it is convenient to start with a protection level corresponding to price P_d^0. If a two-price system is in effect, the domestic market just clears at that price. Both production and consumption are at level C_0 and deficiency payments amount to area acd. Minimum-access import requirements of size ab (=ed) have a different trade effect depending on how the government reacts. Let us assume that pure demand- or supply-side policies, as discussed in the section on export subsidies, are considered infeasible. (If they are feasible, there is no reason to introduce a two-price system in the first place.) In this case, the government has to reduce the subsidized quota assigned to domestic farmers from C_0 to Q_1 if the domestic support price is kept constant. If deficiency payments are raised sufficiently, that is, by amount fade, farmers will be as well off as before minimum-access imports if they export quantity $C_0 - Q_1$. As exports happen to be exactly equal to minimum imports, world price will not change as a result of minimum access.

There is no positive trade effect of minimum access; all it does is raise the domestic tax burden. Farmers will be better off, however, if they can sell quantity $C_0 - Q_1$ in the domestic market rather than in the world market. (The government may not be able to prevent this from happening because the commodity does not pass through an easily controllable processing or marketing channel.) In this case the domestic price will drop to P_d^1 and minimum-access imports will have a positive trade effect. In short, superimposing minimum access on a two-price system can guarantee a positive trade effect only if there is a rule that prohibits importing countries from reexporting minimum-access imports or exporting an equivalent amount of domestic production. Without such a rule, minimum access may have a positive trade effect but it is not certain.

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[55] For a production quota below C_0, which corresponds to a support price above P_d^1, farmers could compete in the world markets. Hence they have a strong incentive to produce at least C_0, that is, in excess of their production quota. As it is more profitable for them to sell in the domestic market than to export, the domestic price will fall to P_d^1. See the discussion of deficiency payments earlier in this chapter.

Finally, Figure 8(d) illustrates the trade effects if an X percent minimum-access provision is combined with PFES. At price P_d^0 and prior to PFES and minimum imports, subsidized exports equal distance $Q_0 - C_0$. Without a change in support price, minimum-access imports of size ab would add to the existing surplus (ca). Introducing PFES would imply a levy on domestic production of size ($P_d^0 - P_n$), so that revenue from this levy, rectangle $P_n fgP_d^0$, just equals export restitutions, area jcde. At the production level corresponding to the net price received by farmers (P_n), minimum-access imports are equal to distance fh, whereas total subsidized exports correspond to de (=cj), implying that all required imports are reexported. Distance cg represents the part of subsidized exports that is not due to minimum-access imports.

Although minimum-access imports are reexported in full, they do have a positive trade effect when combined with PFES. This results from both the shift to the right of world import demand due to minimum-access imports and the shift to the left of world export supply. Note in this connection that subsidized exports are not simply rising by the amount of minimum-access imports, thereby canceling out any effect of minimum imports on world price. On the contrary, exports are falling, from ac to jc. This is due to a sizable decline in domestic production (ag) compared with the situation prior to PFES and minimum access. As a result of the production decline, the "homemade" surplus has shrunk to cg. If PFES were implemented alone, without being combined with minimum access, this homemade surplus would clearly be larger than cg, because the revenue of the producer tax depicted in Figure 8(d), area $P_n fgP_d^0$, would greatly exceed export subsidy requirements in the absence of minimum access, area igcd. A larger homemade surplus, however, would imply, ceteris paribus, a smaller shift to the left of the world export supply curve, and hence less of a positive trade effect. Finally, it should be noted that adding minimum access to PFES will have an increasingly smaller effect on world price the less elastic domestic production reacts to price. In the section on PFES it was noted that a completely inelastic domestic supply schedule deprives PFES of any trade effect. Adding minimum access to PFES will not change this result.

To sum up, if an X percent minimum-access provision were introduced without combining it with restraint on export subsidies, either in the form of a complete ban or limiting them to PFES, it would be unlikely to have any appreciable positive trade effect. The introduction of or an increase in subsidized exports, either in explicit or implicit form, would be a natural avoidance strategy for import-protecting countries. Whether this is also affordable for a country depends largely on budgetary considerations. For countries with sufficient budgetary resources, no adjustment can be expected. For others, some reduction in the protection level and hence some positive trade effect could come forth. Basically, the choice for countries would be qualitatively the same as the one faced by any import-protecting country without minimum-access import obligations. Minimum-access imports just make the budgetary pressure more pronounced. But, clearly, they do not force upon a protecting country a particular internal response pattern. In particular, minimum-access imports do not manage by themselves to establish a link between domestic price and world price.

Without a ban on export subsidies, an X percent minimum-access provision can at most guarantee a quota rent for the exporter to the protected market. For the case depicted in Figure 8(b) the rent would amount to rectangle bcde, and for the case of Figure 8(d), to area ejgi. These rents, however, materialize in full only if quota imports are tariff-free. (Should traders in the importing country receive licenses for the amount of the quota imports, possibly as a result of a competitive bidding process, the quota rent, after subtraction of any tariff, would be reaped by importers rather than by exporting countries.) Should imports be subject to tariffs, then the quota rent is reduced accordingly by the tariff. Minimum-access rights would not give those countries that happen to fill the minimum import quota an increase in overall export quantity. Rather, their exports to the minimum-access countries would be just matched by an export decline in third-country markets that are not subject to minimum access. This occurs because the countries subject to minimum-access imports are likely to increase subsidized exports to these same third-country markets.

If export subsidies are prohibited, an X percent minimum-access provision can be expected to generate a one-time positive trade effect, as import-protecting countries that are self-sufficient or close to it are forced to import minimum-access quantities. Over time, as production increased relative to demand, minimum-access imports would force the import-protecting country to lower the domestic support price to balance demand and supply. (This is true regardless of whether minimum access is defined in terms of production, as recommended, or in terms of consumption, as in Article XI:2(c).) Although the domestic price adjustment is a desirable result, the simultaneous freezing of import quantities or shares that would result is not. It effectively blocks the forces of comparative advantage from operating and hence contradicts the very spirit of the General Agreement.

An advantage of minimum-access import requirements is the relative ease with which they can be monitored. This is independent of the type of protection system used and applies to both the minimum-access rule of Article XI:2 and the suggested X percent minimum-import provision. Quantifying minimum access is hardly a problem for the minimum-access rule of Article XI. All that is required is a decision on the base period on which the market share reserved for imports is based. Quantifying the X percent rule, however, is far less straightforward. Should minimum-access imports amount to at least 10 percent of domestic production for a natural importer? Should that figure be the same for all commodities? These are difficult questions that would have to be resolved in the process of negotiation.

The minimum-access guarantee of Article XI is specific to agriculture. Restricting agricultural trade reform to tightening Article XI by adding an X percent provision and, possibly, a ban on export subsidies, would mean continuing to treat agriculture as a special case with its own rules of behavior. Treating agriculture as a special case in the GATT negotiations, though, has a number of distinct disadvantages from a political-economy perspective. (These were detailed in Chapter 4.) However, there is nothing about minimum access that makes it specific to agriculture on a priori grounds. A minimum-access rule like the one laid down in Article XI and amended by an X percent provision could very well apply to all trade, regardless of sector. If minimum access is interpreted in this more general form, it could be employed to condition the use of any type of trade-restricting measure apart from bound tariffs. This idea will be taken up again in Chapter 6, where it is incorporated as part of a trade reform proposal.

Tariffication or Global Quotas

Bound tariffs are the principal exception to free trade envisioned by the GATT. The reason is that they preserve the main principles of the GATT, such as reliance on the price mechanism and nondiscrimination, as no other trade restriction can. In agriculture, however, nontariff barriers to trade play a more important role than tariffs, thereby excepting the sector from central GATT principles. Tariffication is a reform proposal that is intended to reverse this. Among economists this idea has a wide following.[56]

Tariffication has two objectives, one for the long run and the other for the short run. Its long-run objective is to replace all nontariff barriers and unbound tariffs with low bound tariffs. To minimize distortions of resource allocation, it is widely recognized that these bound tariffs should be uniform for broad commodity groups. In the short run, tariffication implies that the existing nontariff barriers would be converted into their respective tariff equivalents. This would clearly mean that, for many agricultural products and countries, the resulting tariff equivalents would be far in excess of the bound tariff rates that may exist currently or that are envisioned to apply after the adjustment to a tariffs-only world has been completed.

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[56] Advocates of this approach include, for example, Koester (1987), Patterson and Patterson (1986), and the cosigners of Institute for International Economics and The Institute for Research on Public Policy (1988).

In some form or other, then, countries have to be released temporarily from the obligations associated with bound tariffs. In order to avoid a permanent increase in tariff rates, however, the duration of this exception would have to be strictly limited. Preferably, a schedule of mandatory tariff reductions, from the tariff equivalent down to the existing bound tariff rate, should be attached to a temporary waiver on the tariff concessions. To reduce the possibility of prohibitive tariffs during this adjustment period, countries could be obligated to abide by the minimum-access rule of Article XI:2; that is, importers would be required to preserve the historical market share of imports during the transition phase.

The trade effects of tariffication can be analyzed conveniently if it is pitted against a potential alternative trade reform, the conversion of all nontariff barriers into a global quota rather than tariffs (see Hufbauer and Schott 1985 for a discussion of this alternative). Gradual liberalization would then proceed in the form of increasingly larger quotas over time. Global quotas have features similar to those of tariffs. They are nondiscriminatory, easy to administer and monitor, and address only the problem of frontier barriers. A major difference lies in the fact that global quotas do not establish a link between domestic and world prices at a given quota level. Not only does this mean that an important GATT principle is violated, but it also has certain consequences for the development of trade.

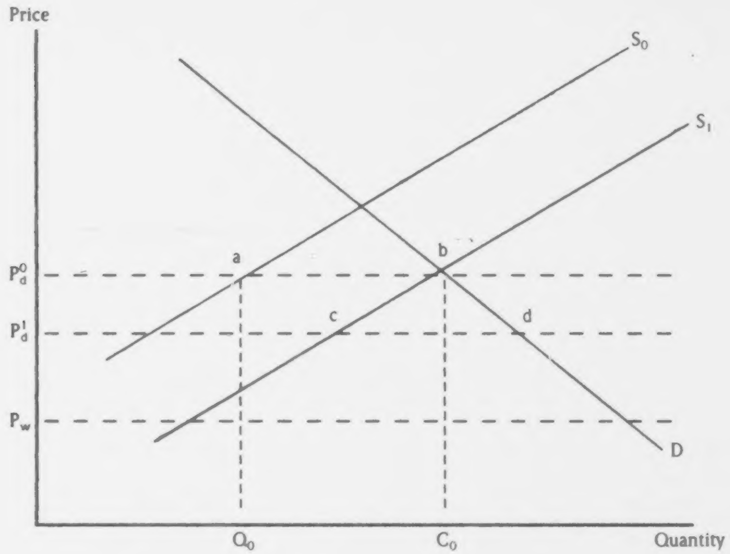
In the short run and for a given world price, replacing nontariff barriers with tariffs of the same restrictive effect changes neither domestic price nor the overall level of trade. However, the composition of imports, assuming the tariff equivalent is not prohibitive, may change if some of the nontariff barriers formerly discriminated trade by origin. A global quota would not differ from tariffication in this short-run respect. This ceases to be true if the assumption of a constant world price is relaxed. A lower (higher) world price increases (lowers) imports in the case of tariffs, but has no trade impact in a world of quotas. The trade effect resulting from tariffication moderates world price changes. Hence world price fluctuations should decline under such a system.

Over time, as domestic demand and supply curves shift, a constant tariff equivalent also has different consequences from a fixed quota. Take first the case that is usually quoted in this context: demand growth exceeds domestic production growth. A fixed import quota implies no growth in imports but rather an increase in the level of protection. For a bound tariff, in contrast, imports increase by the full amount of excess demand growth. Hence tariffs ensure a positive trade effect; quotas do not, unless the quotas are made adjustable upward, possibly through some automatic escalator system triggered on demand growth.

Take now the reverse case of production growth outstripping demand growth. For a constant tariff, imports decline; for a fixed import quota, this is not the case as long as export subsidies are prohibited and the domestic support price is above the world market price. The global quota will have an effect equivalent to minimum-access import guarantees under these conditions. This point is illustrated in Figure 9.

Before the domestic supply curve shifts to the right from S_0 to S_1, an ad valorem tariff of $(P_d^0/P_w) - 1$ percent and an import quota of size ab both establish a domestic price of P_d^0, with imports being equal to $C_0 - Q_0$. After the shift of the supply curve to S_1, imports cease under the tariff arrangement, whereas they remain constant for the case of the quota. If export subsidies are prohibited, the domestic price level declines from P_d^0 to P_d^1 under the quota arrangement (cd = ab), whereas it stays constant under the tariff regime. The price decline under the quota arrangement clearly assumes that the government follows a market-oriented policy. As was discussed at length in the section on export subsidies, any number of alternative reaction patterns is possible, from pure demand-stimulating policies to two-price systems. Any of these policies could avoid or moderate the decline in the domestic support price. In short, there

Figure 9—Tariffs and global quotas with domestic production growth



is nothing automatic about the price decline under the quota arrangement and the ban on export subsidies.

If export subsidies are not prohibited, then a country under the quota regime could choose to export quantity cd with the help of export subsidies rather than allow the support price to fall from P^0_d to P^1_d. Although gross imports would not diminish in this case, as they would under the tariff arrangement, net imports would be zero, just as in the tariff case. From the perspective of nonsubsidizing exporters, then, there is little difference between the quota or tariff regime if export subsidies are allowed.[57] The world price would tend to drop in either case.

Tariffication gives rise to another concern that is absent in the case of a global quota. Countries may resort to gray-area measures such as voluntary export restraints or orderly marketing agreements. This is not a development one would expect immediately, as tariffs are set at their nontariff barrier equivalent, but only over time, as these high tariff rates are lowered to their bound levels. This concern is not unfounded on an a priori basis, given the historical experience with tariff reductions in many segments of manufactures.

In numerous industries, tariff cuts negotiated in previous multilateral trade negotiations were subsequently reversed, at least partially, through the introduction of such gray-area measures. As new low-cost suppliers enter the market on a broader basis, this tendency seems to gain increasing momentum, spreading across more and more industries. In agriculture, however, this threat is probably of less concern for at least two reasons. First, new low-cost suppliers, such as the newly industrialized countries in industrial goods, are not as easily created in agriculture as in industry. Availability of fertile land and appropriate climate are strong constraining factors. Few if any new competitors can be expected to appear on agricultural markets, although some traditional ones, particularly in Latin America, still have considerable growth potential. Second, voluntary export restraints and orderly marketing agreements are largely levied against developing countries, especially the newly industrialized countries. Compared with the major suppliers in agriculture, such as the United States, Canada, and Australasia, they have little political or economic clout to withstand trade restrictions.

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[57] The case of a potential quota rent is disregarded here for simplicity.

Some comments are needed on the political-economy implications of tariffication versus global quotas. Quotas seem to be preferred over tariffication among farmers. The trade effect of quotas is considered more predictable because, unlike that of tariffs, it is not subject to the vagaries of estimating demand and supply functions. It is also independent of changes in relative costs. Predictable or unforeseen changes in comparative advantage, in other words, have no bearing on trade flows. Furthermore, high tariff levels for agriculture would be difficult to explain to voters as well as to industries not subject to similarly high protection levels. Quotas are not standardized in the way tariffs are and are thus harder to pin down in their restrictive effect for the uninitiated observer.

A system of global declining quotas also has a definite disadvantage from a political-economy point of view. It is generally agreed that zero tariffs or quotas at the free-trade level are unrealistic for the foreseeable future. Hence, the end point of the process of tariffication would be realistically the establishment of a system of relatively low bound tariffs, not free trade. In terms of global quotas this would translate into quotas close to, but not equivalent to, the free-trade level. As demand and supply change over time, no government decision is required under the tariff system. The level of protection remains the same. Under a quota system, changes in demand and supply would require constant adjustments of the quota to keep its protective effect constant. This naturally gives rise to continual conflicts with the affected producers. It deprives governments of the protective shield against the demands of special interest groups for protection that is characteristic of a tariff. A tariff automates domestic price decision by linking the domestic price to the world price; a quota arrangement does not.

Binding the Level of Protection

Choices in Defining the Level of Protection

An alternative to restricting the use of specific instruments with a direct trade impact is to bind the level of protection, defined either separately for each commodity or jointly, that is, commodity-independent, for the country as a whole. Such a scheme would allow each country to decide on its own what trade-inhibiting measures to apply, as long as the level of protection stayed below a certain threshold as written into the country's GATT concessions. This threshold-protection level could be determined either by reference to a particular year or average of past years or by free negotiation among the GATT signatories. At any rate, once agreed upon, it could be bound in exactly the same way as a tariff.

Such an approach is not all that new. Something rather similar was put on the negotiating table once before during multilateral trade negotiations. During the Kennedy Round the EC made such a suggestion in the form of the *moutant de soutien* or "margin of support" strategy. The proposal was rejected by the United States at that time because it did not contain minimum-access guarantees to the EC market and endangered U.S. market access to the EC for products covered by bound tariffs. At present, there is again intense interest in the binding of protection levels as a way to halt the growth of protectionism in agriculture. The choice seems to boil down to one of the following three methods of measurement: nominal rates of protection (NRP), effective rates of protection (ERP), and the overall level of protection as measured by

Producer Subsidy Equivalent (PSE) or any of its derivatives, such as Trade Distortion Equivalent (TDE).[58]

The NRP is widely used in empirical analysis. Its popularity stems in part from its relative simplicity and the intuitive sense it makes. As the NRP is based on a comparison of domestic and world market prices, the data requirements are rather limited. All that is needed is information on two prices for each commodity. Despite its simplicity, the NRP measure has the advantage that it captures the most important protectionist measures quite adequately, making avoidance strategies on the part of protecting countries more difficult. The reason is that common protectionist measures, such as variable levies, tariffs, quotas, and the protectionist activities of state trading enterprises, directly affect the price differential between domestic and world market prices. Increases in the level of protection through these trade policy instruments generally show up in a greater differential between world price and domestic price.

However, there are some well-known cases for which the incentive effect of protection to producers, and hence the ultimate trade effect, is not fully captured by the NRP. One such case occurs when the inputs used in the production process are subject to levels of protection that are very different from those on the final product. In this case, the NRP on the final product underestimates the incentive effect to producers and, hence, the trade effect. The ERP is meant to correct for this shortcoming. It takes into account differences in the level of protection among inputs and final product.

Although the ERP better captures the true level of protection accorded to an economic activity, this measure also has its shortcomings. First and foremost, its calculation is far from easy. It requires a considerable amount of detailed information about input-output relationships—information that is simply not available in many cases. This is reflected in the limited number of empirical studies utilizing this measure for more than a few select products. Furthermore, it is unlikely that imported inputs play a large role for the majority of primary agricultural products that are being traded.[59] Finally, the ERP has one serious flaw in its use as a measurement concept that is of particular importance for heavily protected agricultural products, that is, the ERP is difficult or impossible to interpret when free-trade value added is low or negative. The ERP measure will assume very large positive or negative values under these circumstances, thereby rendering it ineffective for measurement purposes.

The NRP measure is a poor guide to the trade effects of government policies in a number of other instances apart from the case of differential rates of protection on inputs and final products. Examples are deficiency payments, input or production subsidies, and voluntary export restraints with the quota managed by the exporter.[60] In these cases the NRP may fail to establish a unique link between measured price difference or the lack thereof and the measure's trade impact. This has been illustrated for the case of deficiency payments in connection with Figures 5 and 6. If farmers receive deficiency payments only for the quantity they would produce in the absence of import barriers, these payments have no negative trade effect. This applies equally in the case where the country is an importer at the given world price and where it is an exporter. Hence an NRP of zero would correctly indicate the absence of negative trade effects, assuming consumers can buy at the world price. Deficiency payments beyond the quantities that would be produced in the absence of protection, however, do affect trade by either reducing imports or increasing exports. The NRP measure fails to show a negative trade effect in this case.

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[58] TDE is equivalent to PSE except that it intends to capture only government support measures that are explicitly trade-distorting. The Canadian proposal for agricultural trade reform at the Geneva talks is based on this measure.

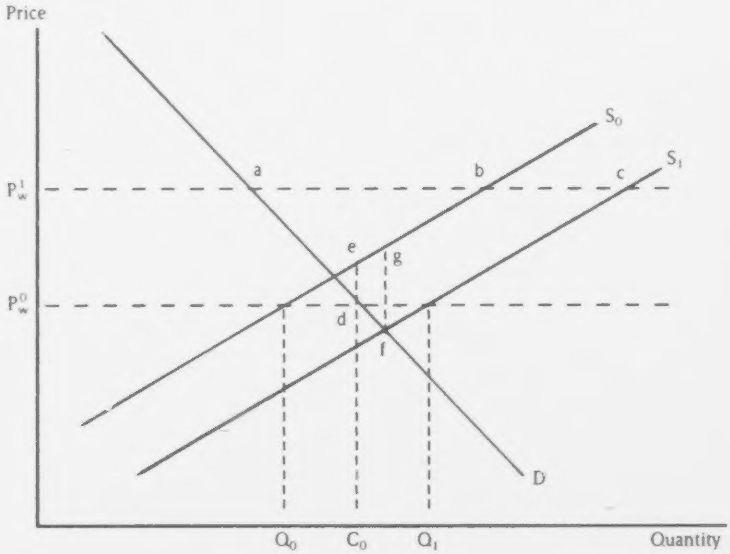
[59] This is not to say that there are no cases in agriculture where the ERP is likely to be significantly above the NRP. One example would be the protection of the meat industry in the EC. Its NRP is high, but the low tariffs on feed imports, such as soybeans and citrus pulp, make its ERP even higher.

[60] The NRP will be affected by the voluntary export restraint only if a price other than the import price is used as a proxy for the world price for the purpose of comparison with the domestic price. A very similar argument holds for health and other standards that imports have to conform to.

The NRP measure is even less useful in handling production subsidies than deficiency payments. It will never be able to identify the trade-distorting effects of subsidies. This is illustrated in Figure 10 for two alternative levels of the world price. To focus on the subsidy effect, the world price is assumed to be equal to the prevailing domestic price in each case. Before the introduction of production subsidies, the country is a net importer of quantity $C_0 - Q_0$ at the lower world price (P_w^0) and a net exporter of quantity ab at the higher world price. A per-unit production subsidy of sufficient size, that is, in excess of distance de, will make the country a net exporter even at price P_w^0. The subsidy identified by fg, for example, induces exports of size $Q_1 - C_0$. At price level P_w^1, a subsidy of this same size raises exports from ab to level ac. In neither case, however, is there a change in the NRP measure, yet negative trade effects certainly exist.

The latter two cases, that is, deficiency payments and domestic subsidies,[61] are typical examples of the rationale for extending the NRP measure into PSE. The overall level of protection as measured by PSE is a refinement or extension of the NRP measure in the sense that per-unit transfers received by farmers are added to the NRP measure if their effect on production is not already captured by the NRP.[62] Unlike the ERP, PSE does not rely on in-depth knowledge

Figure 10—Trade impact of domestic subsidies at different levels of world price



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[61] Denaturing premiums that are paid to convert a surplus product into a product for which the domestic surplus is less acute can also be considered production subsidies, although not for the denatured product (for example, wine), but for the end product (for example, industrial alcohol).

[62] The idea of PSE originates with Josling, as developed in FAO 1975. In-depth discussions and practical applications can be found in Organisation for Economic Co-operation and Development 1987; Tangermann, Josling, and Pearson 1987; and U.S. Department of Agriculture 1987.

of technical input-output relationships. The measure is similar to the NRP in that the problems addressed by the ERP are not explicitly considered.[63] PSE's major advantage over the NRP is its more comprehensive coverage of governmental polices. PSE captures policies, such as subsidies, that have a potentially negative trade effect, yet do not change the differential between world price and domestic price and hence the NRP.

Evaluating the Usefulness of Bound Protection Levels

Binding the protection level, whether in terms of the NRP or PSE, is fully consistent with the GATT's emphasis on the price mechanism. However, only if the protection level is defined in terms of PSE will world price fluctuations feed through to producers, either as changes in price or as transfers. This applies regardless of the intervention scheme that is applied by the government if PSE is defined in a very comprehensive manner. But given such a definition, PSE can dramatically reduce the possibilities open to governments to avoid the consequences of bound or reduced protection levels. For example, the substitution of domestic subsidies for export subsidies would be clearly impossible. PSE's advantage over the NRP lies in its ability to add up measures with direct and indirect trade effects in a consistent manner. This makes it appealing to anyone who thinks that the GATT's emphasis on measures with direct trade effect, that is, frontier barriers to trade, is in need of revision. PSE is flexible enough to allow the inclusion of only those government market interventions that have an actual or potential negative trade effect. As subsidies are constrained by PSE, both productivity increases and their expansionary effect on domestic supply or exports are curtailed. In that sense, PSE seems rather resilient to the trend in supply growth, whereas the NRP lacks that characteristic.

PSE also has a number of drawbacks. Probably its most serious disadvantage, one that it shares with the NRP, is that it keeps the door wide open for protecting countries to discriminate among trading partners. For example, nothing stands in the way of protectionist countries' continuing or switching to a system based on voluntary export restraints, discriminatory quotas, or selective tariffs. How this element of trade discrimination could be handled in a world of bound levels of protection is an open question. What is clear, however, is that the GATT principle of nondiscrimination is not enforced automatically through any such scheme. The only way nondiscrimination could be effected if overall protection levels were bound would be through some ancillary arrangement, such as increasing the monitoring capability of the GATT or some other organization, and possibly providing for the option to intervene when a case of trade discrimination becomes apparent.

Discrimination could be a particularly serious problem if the overall protection level is bound—not for each commodity individually, but for a group of commodities or for all agricultural commodities traded by a country. Under such a scheme, each country would be able to decide on its own how to allocate its protection allowance among individual products (such a possibility is suggested in Tangermann, Josling, and Pearson 1987). It would allow countries to extend protection for those commodities they consider most important for their farmers and resort to free trade for less important products. This flexibility probably has more negative consequences than positive ones. It would give politicians great latitude in supporting markets at levels far removed from levels consistent with comparative advantage. World markets could end up severely distorted for certain products on which a large share of the protection allowance is concentrated. This could be devastating for nonsubsidizing exporters that rely on these products but do not also trade in other products for which protection has declined at the same time.

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[63] Conceptually, however, it appears feasible to modify PSE to incorporate the information content of ERP. It would be necessary to calculate the value of the per-unit tariff concessions, relative to the product being analyzed, for those inputs that are subject to lower protection levels and add them to the NRP or other government outlays affecting the product.

Further, nonuniform protection could worsen existing negative trade effects or create new ones through its impact on the ERP. In short, the possibilities of negative trade effects through uninhibited trade discrimination are staggering. As always, discrimination and selectivity are going to hurt most those countries with less political or economic clout. In all likelihood, these will be developing countries. This makes PSE a questionable choice as the main theme of trade reform in agriculture, particularly if it is not intended to apply to each commodity separately but to groups of commodities on average.

A related disadvantage of fixing the overall protection level, in the form of the NRP or PSE, is the difficulty of exactly pinning down the resulting trade effect. Some examples may illustrate this point. Take the case of subsidies as pictured in Figure 10, a case that seems to be predestined for the application of PSE. Yet it is easy to see that a production subsidy of size de per unit does not have the same effect on trade at price P'_w as would raising the protection level and support price by the same amount. In the former case imports cease, whereas in the latter case not only do imports cease but subsidized exports are forthcoming, making for a much worse trade effect. Deficiency payments pose another serious problem for the NRP or PSE. Figure 5 can illustrate this. As per-unit payments of size (P_t - P_d) are not incorporated in the measurement of the NRP, because they have no additional trade effect, the NRP, as calculated from P_d and P_w, would be the relevant measure of protection. Yet the NRP, if applied to domestic demand and supply curves, would predict exports of size dc, although they have ceased altogether. Hence the NRP measure would vastly overestimate the negative trade effect of a two-price system as pictured in Figure 5.

The above cases can equally well serve to demonstrate that the binding of protection levels, by the NRP or PSE, would allow a country to change over from a protection scheme with minimal negative trade effect (for example, a two-price system) to one with maximum negative trade effect (for example, a variable levy cum export subsidy system).[64] This example, although somewhat extreme, nevertheless reveals an inherent weakness of the binding of protection levels.

A number of measurement problems further weaken the case for the NRP or PSE as a basis for trade reform. One facet of this problem is the issue of quality differences. They are reflected in price differences the same way as protective measures. This is an important point for highly differentiated products, for which competition is at least to some extent based on quality. Beef, for example, is such a product. The problem of quality differences is of less importance for standardized products, such as refined sugar.

Another measurement problem—applicable only to PSE, not the NRP—relates to the identification of all subsidy expenditures on farm programs. It should come as no surprise that subsidy levels as reported by governments generally underestimate the true ex post levels.[65] Incomplete reporting, hiding of funds in other budget items, special mid-budget-year appropriations, and disbursements of funds from even less-clear budgets at other than the highest government level help to confuse the true magnitude of government support. The funds expended to support agriculture in the EC, for example, come only partially from the EC budget, although most international comparisons are based only on those figures. Disbursements by national governments, however, probably double the true amount of financial support to the farming sector in the EC.

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[64] Note that export restitutions are not added to the NRP measure because this would involve double counting. The trade effect of a variable levy cum export subsidy scheme is fully captured by the simple NRP.

[65] It is not uncommon to find independent investigators uncovering levels of subsidization far in excess of those officially published. See, for example, Jüttemeier 1987 for details on the West German case.

Finally, as the work of the OECD on PSE amply demonstrates (Organisation for Economic Co-operation and Development 1987), governments manage to complicate certain intervention schemes over time so that reliable estimates of their effects become extremely difficult. This is mainly because the initial interventions lead to unexpected results, such as steep unsustainable increases in program costs. As a reaction to budgetary pressures, "quick fixes" are added in an unsystematic manner, making the whole system ever more bureaucratic, less efficient, and harder to comprehend.

A further measurement problem relating to the fixing of overall protection levels derives from the strong dependence of the NRP and PSE on levels of exchange rates. Although exchange-rate fluctuations also affect other reform ideas, they are by far the most important for measures of overall protection that rely on price comparisons. (The exchange-rate issue is taken up again in Chapter 6.) Recent experience has shown that exchange rates can vary rather dramatically and over short periods of time. A depreciating dollar, for example, can increase the NRP both for goods quoted in dollar prices and for countries outside the dollar zone without there being a change in agricultural markets, import protection, or world prices. The reverse case, an appreciating dollar, would allow countries outside the dollar zone to raise domestic prices, and hence to upset trade relations, without violating the bound NRP. These problems are obviously serious, but how to handle them in actual measurement practice is far from clear. Simple three-year averages of exchange rates or similar schemes can dampen fluctuations; they do not eliminate the problem.

Bound overall protection levels would also cause problems for agricultural policy in times of wild fluctuations in world price. Averaging would again lessen the need for sharp policy adjustments. Yet major problems remain if world prices move in an unexpected direction at the end of a period whose average is compared with the bound level of protection. It has been suggested (Tangermann, Josling, and Pearson 1987) that countries be mandated to use price forecasts prepared by the GATT for guiding domestic policy, especially in the crucial last year or years of a measurement period.

Similar procedures are employed in connection with the compensatory financing facility of the International Monetary Fund (IMF) for export revenues of developing countries. It is unlikely, though, that the analogy is close enough to be meaningful. The crucial difference between the IMF's scheme and the one suggested above is the number and size of countries acting on the same price forecasts. For example, if the EC and the United States—both major players on the world market for numerous commodities—act on a given set of price forecasts, these forecasts are certain to turn out wrong ex post. They will be self-defeating. The situation is qualitatively different if a small developing country with moderate or no influence on the world price is involved, as is common for the IMF's compensatory financing scheme. Above all, however, the compensatory financing scheme does not require adjustments in policy to counteract the price forecasts, as would be the case if it were used to make countries abide by their pledges to bind their protection levels.

Based on political-economy considerations, the adoption of the NRP or PSE measures of overall protection are ambiguous at best. The main advantage of binding the protection level at this stage seems to be the stated unwillingness of the EC to link the trade talks with a discussion of reform of its internal agricultural policy regime. But as export subsidies, variable levies, or other trade-distorting measures are an integral part of domestic policies of farm support, any negotiating strategy that focuses on the removal of these measures could run into difficult problems at the negotiations.

The NRP or PSE, in contrast, would provide maneuvering room for governments, allowing them to choose those protective measures that are politically the most acceptable, within the obligations imposed by the NRP or PSE. But the considerable amount of discretion provided by the NRP and PSE also happens to be a potential problem: it subjects the government to constant pressure from the farm lobby. Finally, PSE or even the NRP cannot be seriously considered as a theme for the Uruguay Round in general. The problems of quality differences are too major for much of manufacturing to be ignored. As a result, adopting the NRP or PSE in agriculture, but going an entirely different route in manufacturing, would establish agriculture officially as a special case, with all the attendant problems outlined in detail in Chapter 4.

In sum, both the NRP and the PSE or any of its derivatives seem unsuitable as a basis for legal commitments by the GATT contracting parties. Binding the overall protection level cannot serve as the sought-after unifying theme of the Uruguay Round. However, this does not mean that PSE is useless for the GATT negotiations. Even if it should not be incorporated in any form into the General Agreement, PSE or any of its derivatives can serve a useful function as a measuring device during the negotiations to facilitate compromises and to set targets for liberalization, or as a monitoring device thereafter to check on the progress of trade liberalization over time.

6

OUTLINE OF A TRADE REFORM PACKAGE

The Basic Elements of the Reform Proposal and Its Rationale

The objective of multilateral trade negotiations under the aegis of the GATT has been and will continue to be the elimination of frontier barriers to trade, in agriculture as well as in other areas. Although political conditions make achieving this long-run objective highly unlikely in the short run or probably even in the medium run, it is important not to lose sight of it. Any idea for trade reform should, at a minimum, provide a smooth transition to this objective rather than obstruct its eventual achievement. The most important criteria by which to judge whether a reform proposal fits into this category were set out at the beginning of this study and have been applied subsequently in the evaluation of numerous ideas for trade reform. It is apparent from this analysis that all the criteria that have been established could probably not be satisfied by a single idea or element of trade reform. But an appropriate combination of reform ideas may achieve this end; the one favored by the authors would consist of a strict ban on export subsidies combined with comprehensive tariffication.

The ban on export subsidies would eliminate the special treatment for agricultural, fishery, and forestry products in the General Agreement and the Subsidies Code. All goods would be subject to the same disciplines on export subsidies. In terms of the GATT code this implies the elimination of Article XVI:3 from the General Agreement and Article 10 from the Subsidies Code. The remainder of Article XVI of the General Agreement and Article 9 of the Subsidies Code would be changed to cover all products, regardless of sectoral origin. The Annex to the Subsidies Code (see Appendix 2) could also be amended to include some more pertinent examples of export subsidies that are specific to agriculture.[66] In this way, certain cases of indirect export subsidization that were mentioned in the context of deficiency payments schemes in Chapter 5 could be captured. As was concluded there, indirect export subsidies by countries that would be importers in the absence of import protection are easily identified by the existence of net exports despite positive rates of protection. Identifying indirect export subsidies for a competitive exporter that maintains no import restrictions was considered less clear-cut theoretically, although still possible if a pragmatic attitude is maintained. A simple solution would be to disallow deficiency payments on output levels in excess of domestic consumption. This would eliminate, among other things, the export subsidy problem associated with the current U.S. practice of disbursing deficiency payments on all domestic production, subject only to participation in acreage reduction programs.

Tariffication, the second element of the suggested trade reform package, consists of (1) replacing all unbound tariffs and nontariff barriers, such as variable levies, quotas, and voluntary export restraints, with bound base tariffs that are uniform across broad commodity groups for each country;[67] and (2) extending the tariffication idea to the safeguard Article XIX. The bound base tariff of part (1) is a country's basic tariff concession. It is the tariff level that would be applied uniformly across broad commodity groups by a given country after completion of the adjustment to a system based only on tariffs. Unless it invokes Article XIX, a country is bound to this tariff. Unbinding the tariff entails, as currently stipulated in the General Agreement, paying compensation to the affected trading partners or facing retaliation. The base tariff is, quite naturally, also the subject of subsequent multilateral trade negotiations on tariff reductions.

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[66] Note in this context that numerous subsidy practices now common in agriculture would be clear violations of the Subsidies Code and its Annex even without its amendment. An example is the transportation subsidies granted to Canadian grain destined for export (see Organisation for Economic Co-operation and Development 1987, 282).

[67] Tariffs should certainly be uniform across commodities with significant cross-price elasticities; for example, grains and grain substitutes. Tropical products is another example.

As it is probably politically impossible to shift from the current system of almost universal nontariff protection in agriculture to one of bound tariffs, and that at a relatively low uniform level, any agreement on tariffication will have to contain provisions for temporary import relief for the time period needed to restructure the industry or, at least, domestic support programs. Part (2) of the tariffication idea addresses this need. Once the adjustment period is over and a system of bound tariffs has been established, its major use would be to condition the response of importers to import surges according to Article XIX.

Extending tariffication to Article XIX implies that safeguard measures are limited to temporary tariff increases, applying by definition to all imports, regardless of source. Quotas are eliminated as safeguard measures, since they contradict the basic principles on which the GATT is founded. A revised safeguard Article XIX is envisioned to operate as follows. A country using a temporary tariff increase, here called an excess tariff, would bind itself to a timetable for lifting the safeguard measure. This timetable would specify the dates on which the excess tariff would be reduced as well as the step size of the individual reductions. Noncompliance of the country with this timetable would be a cause for compensation or retaliation by the affected trading partners. In accord with the current GATT rules relating to the unbinding of tariffs, a country would compensate its affected trading partners when it imposed a temporary excess tariff. Compensation payments should probably be automated to take the controversy out of them. A provision could be added to the safeguard article that would automatically transfer all tariff revenue on the product subject to an excess tariff, or a multiple thereof, to the governments of the affected exporting countries. To avoid the problem of prohibitive tariffs, the use of excess tariffs under the safeguard article could be conditioned on some minimum-access provision similar in spirit to that currently written into Article XI:2(c) of the General Agreement.

It is understood that Article XI:2(c) would be discarded in its present form, which limits it to agricultural or fishery products, because comprehensive tariffication implies that all special sectoral provisions are eliminated from the General Agreement. Article XI:2 could be rewritten so as to apply to all trade regardless of sector and whenever a country uses any import restriction other than its bound base tariffs. (In this context, "other import restrictions" means excess tariffs as applied under Article XIX, since this is the only legal escape mechanism under the suggested system of comprehensive tariffication.) A provision could be added to ensure that the market share reserved for imports would be distributed in a nondiscriminatory way. Reference could be made to Article XIII of the General Agreement for that purpose.

A question arising in this context relates to the conditions under which a country should be allowed to resort to excess tariffs. The criteria that currently apply for safeguard actions according to Article XIX could be extended to the revised safeguard article. Alternatively, the article could be modified along the lines of a more comprehensive definition of injury. For example, it has been suggested that the term "injury" be given an economy-wide perspective rather than limiting its interpretation to the producers of a particular range of products (Laird and Sampson 1987). In any case, the excess tariff provision would be applicable during the adjustment process from the current system of protection to one based solely on bound uniform tariffs. It is expected to be the primary means of achieving a system based only on bound uniform tariffs. Excess tariffs could provide temporary import relief for all products now protected by nontariff barriers with tariff equivalents much greater than the uniform base tariff that a country would adopt after adjusting to the new system.

Countries may resort to gray-area measures to reduce the adjustment pressure that grows from lowering excess tariffs to the level of the bound base tariff over time. In this context, four types of measures are particularly applicable to avoidance of tariffication disciplines: voluntary export restraints, state trading arrangements, domestic subsidies, and exchange-rate manipulations. Their likely significance will be discussed in turn, along with possible ways to contain their use.

In industry, voluntary export restraints could become the preferred way to circumvent the revised safeguard article, just as they have been the preferred mechanism to avoid the current safeguard article (see Sampson 1987 for quantitative evidence). Although voluntary export restraints are less likely to become a major problem in agriculture, they have to be addressed by any reform package that claims, as this one does, to be applicable for trade in general, not only for agricultural trade. Voluntary export restraints could be explicitly prohibited, with the GATT Secretariat actively supervising this prohibition. The Secretariat would have the right to initiate cases against any country that forced export restraint agreements on its trading partners, thus reducing the likelihood of government-sponsored voluntary export restraints. It would not be able, however, to contain export restraint agreements negotiated between companies of importing and exporting countries—an area for domestic cartel legislation, not for the GATT.

Currently, voluntary export restraints are less frequent in agriculture than they are in nonagriculture. One reason for this is the existence of another very popular escape mechanism in agriculture, state trading (see Article XVII). Examples of state trading arrangements just from the dairy sector include butter imports into Canada, butter and milk powder imports into Japan, Swiss butter imports, and dairy exports of New Zealand. Furthermore, most of the trade in wheat and coarse grains is channeled through state trading agencies (see Hathaway 1987). Although Article XVII of the General Agreement stipulates that state trading enterprises are to operate in a manner consistent with the General Agreement, little attention is paid to the relevant GATT rules in practice. In fact, state trading has been a convenient way to impose frontier barriers. It obviates the need to invoke official safeguard measures or provide explicit export subsidies. Yet no GATT dispute has ever been initiated that focused on the practices of state trading enterprises. This is probably because it is generally realized that official complaints are unlikely to bear any fruit, anyway. The rules of Article XVII are simply too loose to be of relevance.

To close this loophole, there is an urgent need for better disciplines on state trading arrangements. Treating export subsidies in agriculture the same way as elsewhere should go a long way in eliminating implicit export subsidies by state trading enterprises in agriculture. Implicit quantitative import restrictions, in contrast, are more difficult to prevent. An outright prohibition of state trading enterprises would be preferable and certainly would be the logical extension of comprehensive tariffication. But such a prohibition is unlikely to be politically feasible. Trying to discipline state trading enterprises through detailed rules on accounting may also be doomed because of the many diverse functions they can be assigned to fulfill. The only practical solution may be to restrict their operations on the import side indirectly through binding the NRP for all those goods under their control. In particular, a provision could be added to Article XVII to the effect that the price difference between the border price and the domestic wholesale price of products under the control of state trading enterprises should not exceed the equivalent of the bound base tariffs for those products.

Domestic subsidies are another possible way of circumventing the disciplines of tariffication. As the discussion in Chapter 5 has shown, they can, at least partially, undo the effect of a reduction in frontier barriers, including the elimination of export subsidies. A possible way of diffusing this potential problem is by adding a quantitative limit on domestic subsidies to the Subsidies Code's Article 11. Per-unit subsidies could, for example, be limited to a level equivalent to the prenegotiation nominal tariff level for the product in question. As an alternative, subsidy limits could be expressed in terms of a reduced version of the PSE measure, that is, a PSE stripped of its NRP component.[68] The subsidy equivalent could be expressed as a percent of value added for a given industry or product and limited to a maximum value for all countries. The attraction of such a scheme is twofold. Not only would it limit the influence of domestic subsidies on trade flows, it would also give governments a measure of independence from special interest groups and their ever-present demands for handouts. To put it differently, quantitative limits on subsidies would make rent-seeking less profitable and subsidy-cutting easier to implement—a very important point in light of the rather unsuccessful attempts at subsidy reductions observed in many countries. The possible damage that strict quantitative limits on domestic subsidies could impose on well-thought-out plans for correcting market failures should not be overestimated. In reality, a great many subsidies relating to tradable goods are neither well thought through nor do they attack true market failures.

A quantitative limit on domestic subsidies also has certain disadvantages. As discussed in detail in Chapter 5, domestic subsidies are inherently difficult to identify and quantify. Also, countries differ widely in their attitude toward them. Both points could waste a lot of time and goodwill at the negotiating table relative to the expected benefit of a subsidy limit. If a comprehensive tariffication plan is adopted, the subsidy issue will probably lose much of its importance. Indeed, apart from agriculture, there are few areas where domestic subsidies play a major role in trade. (One distinct exception is the civil aircraft industry in the EC.).

Even in agriculture, domestic subsidies with trade effects are likely to be much less of an issue if rates of protection are made uniform across broad commodity groups in agriculture.[69] This is the main reason that the above tariffication proposal calls for *uniform* tariffs. Furthermore, as argued at some length in Chapter 4, relatively low frontier barriers to trade imply a relatively high budgetary cost of domestic subsidies to governments. This cost argument contributes to making domestic subsidies less attractive once tariffication has converted the present trading system into one characterized by uniform, relatively low, bound tariffs. Finally, although numerically fixed subsidy levels or ratios would indeed give governments a protective shield with which to ward off demands for handouts in excess of those limits, there is the danger that governments will not be able to resist demands to raise subsidies at least to the levels allowed.

When the arguments for and against a quantitative limit on domestic subsidies are weighed, doubts may arise as to the value of striving for a general solution to the domestic subsidy issue in the Uruguay Round. If domestic subsidies are not believed to present a major issue under a system of uniform tariffs, a case-by-case resolution of domestic subsidies issues may be more efficient and could be accomplished either in negotiations outside of the GATT or by dispute settlement inside the GATT. For successful dispute settlement within the GATT, current procedures would have to be made much more responsive.[70] This would especially benefit developing countries, whose lack of political or economic influence weakens their position in direct negotiations outside of the GATT.

Government attempts to manipulate exchange rates in order to circumvent the disciplines of tariffication and an export subsidy ban could be handled in the same way as domestic subsidies, that is, without adding new provisions to the General Agreement or its subsidiary codes law. This is not to deny that consistent currency undervaluations or depreciations that aim at gaining a competitive trade advantage can severely distort trade flows. They can indeed reduce imports on a massive scale and at the same time provide decisive advantages in export markets. For all practical purposes, they are functionally equivalent to a combination of import taxes and export subsidies applied uniformly across sectors. (In this context, note that nothing about the exchange rate makes it unique to agriculture.) Exchange-rate undervaluation is not only of theoretical interest. It has been practiced in the past by West Germany and Japan, among others, and is currently used by such countries as Taiwan and Korea.

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[68] The NRP component of PSE, that is, the need to compare border price and domestic price for like products, stands in the way of applying PSE for all products, regardless of sector. This is discussed in more detail in Chapter 5.

[69] It may be conjectured that the vast differences between the protection rates accorded to grains and those for grain substitutes in the EC are the root cause for a good number of vexing subsidy disputes between the United States and the EC. This applies most apparently to the production and processing subsidies that the EC has given to oilseeds since the late 1970s.

[70] Some suggestions on revising the GATT's current dispute-settlement procedures are contained, for example, in Institute for International Economics and the Institute for Research on Public Policy 1988.

In contrast to currency undervaluation, currency overvaluation is of less concern to the GATT (though it is of major concern to the World Bank and the IMF). Currency overvaluation does not displace exports of other countries that would be competitive otherwise, nor does it translate directly into lower imports and reduced market access.[71] Currency overvaluation plays a role for the GATT system only insofar as it may make developing countries less inclined to endorse tariffication. After all, high tariffs are used by many developing countries to compensate for the implicit tax on importables that results from an overvalued exchange rate. Lowering these tariffs would even increase this implicit tax on importables, thereby putting heavy pressure on governments to reduce the degree of exchange-rate misalignment.[72]

Leaving aside the problem that overvalued exchange rates can pose in getting developing countries to accept the idea of tariffication, the GATT has to be mainly concerned with currency undervaluation. But as there are only a few countries in the world with undervalued exchange rates, this area seems to be ideally suited for a bargaining solution rather than an approach based on complex rules that may be impossible to enforce in practice. Political pressure to adjust the exchange rate, similar to that applied to Korea and Taiwan by the United States in recent times, appears to be the proper way to handle the trade problems resulting from undervalued currencies. Besides, it has to be remembered that an undervalued currency is difficult to maintain in real terms over a prolonged period. Consistent currency undervaluation will eventually lead to higher rates of inflation, with a consequent reduction in international competitiveness. In addition, domestic output growth will increase the demand for imported raw materials and intermediate goods. Eventually, imports will also get a boost from rising personal consumption unless high domestic taxes are levied on imported goods. (This appears to be the case for Korea with regard to foreign-made automobiles, for example.) If such taxes are levied, GATT signatories may file a complaint with the GATT under the provisions of Article XXIII.[73] In short, there does not appear to be a compelling reason to settle the exchange-rate issue through amendments to the General Agreement or the addition of a new code.

To summarize, the reform proposal suggested in this study consists of two basic elements: comprehensive tariffication and a prohibition of export subsidies.[74] In order to keep countries from circumventing the disciplines of this reform package, a ban on voluntary export restraints and more effective rules of behavior for state trading enterprises seem necessary.

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[71] Market access can become restricted indirectly over time, as the import-competing industries in a country with an overvalued exchange rate will lobby for import protection—a phenomenon recently observed in the United States.

[72] Krueger, Schiff, and Valdés (1988) show that the importables of many developing countries are subject to high positive rates of protection at the official exchange rate, but receive negative protection, that is, they are implicitly taxed, at the corrected exchange rate.

[73] It may be added that multiple currency practices as opposed to an undervalued exchange rate for all trade is captured by Article VI of the GATT. Such practices can in principle be countervailed. See the text of Article VI and the clarifying interpretations in Appendix 1.

[74] The approach suggested here is close to, though not identical to, the one proposed in Resources for the Future 1988.

The above package has several advantages over such alternative suggestions for trade reform as fixing overall protection levels. The reform proposal relies on well-known GATT instruments and principles rather than untried policy instruments or measurement techniques. This should ease the transition for trade in agriculture and other industries toward the final objective of little or no government interference. The effort to incorporate a completely new approach such as PSE into the GATT framework could not only deadlock negotiations over measurement concepts and problems, but also establish a special case for agriculture, with all the negative consequences that have already been discussed. In contrast, opting for the reform proposal outlined above would fully integrate agriculture into the GATT framework. In fact, a major strength of the proposal's core element, tariffication, is that it could easily form the basis of trade reform within the GATT for all goods-producing sectors, not just agriculture.[75] It could be the sought-after unifying theme of the Uruguay Round and hence play a role similar to the "across-the-board" tariff-reduction idea of the Tokyo Round. (See Chapters 3 and 4 for a discussion of the importance of finding such a unifying theme for the Uruguay Round.)

Tariffication has one characteristic that may lessen its appeal to agriculture: it does not by itself guarantee domestic price stability. Unlike the exchange-rate issue, the question of price stability is unique to agricultural products. It also appears to be of considerable importance to both farmers and agricultural policymakers. For example, even sharp critics of the EC's Common Agricultural Policy concede that it has performed well in achieving the stabilization objective. The question arises as to whether the objective of stable prices warrants giving agriculture some special exemptions from the disciplines of tariffication.

Incomplete markets due to adverse selection and moral hazard prevent farmers from obtaining comprehensive insurance against the output and price risks they face. If this is acknowledged as a market failure, government intervention can be justified. (See a complete discussion of price stabilization in Newberry and Stiglitz 1981.) However, it is questionable whether government intervention should take the form of border measures. Probably the only reason to favor border measures to stabilize prices is their low transaction costs compared with some of the alternatives; otherwise, such measures do not seem a good choice. First, the history of the GATT clearly questions the wisdom of special sectoral exemptions. Indeed, most of the problems with agricultural trade have resulted exactly because of such special exemptions. Second, it is far from certain that the extent of price variability that may still be expected in a system based only on tariffs would be large enough to warrant the costs of government intervention.[76] Although the degree to which world price variability will be less than at present is uncertain, there appears to be no reason to doubt the direction of change. (See Schiff 1985 for a discussion of price variability.) Third, stabilizing domestic price may actually worsen the fluctuations in income if price and quantity are negatively correlated. Fourth, by partially or fully insulating the domestic market from price fluctuations in the world market, border measures worsen the price instability in the world market. This, in turn, tends to raise the problem of price instability for all countries. Price stabilization through border measures has, in other words, negative externalities for other countries. This does not appear to be a desirable outcome from the point of view of global welfare maximization.

Domestic or international insurance schemes that compensate for income losses resulting from price instability seem to be preferable to border measures from the perspective of the

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[75] The ban on export subsidies for agricultural products only serves to bring agriculture up to the same level of GATT disciplines that applies to nonagriculture.

[76] Quota-like variable levies or similar schemes to insulate domestic farmers from world price fluctuations incur the cost of preventing a country from taking full advantage of its comparative advantage.

General Agreement. Certain mechanisms are already in place to deal with such cases. A number of countries have futures markets, others have insurance schemes for selective risks (crop insurance). (See Stiglitz 1987 for a short discussion of alternative responses to the risk of price instability.) Domestic credit programs or special income tax provisions could alleviate the problems of income fluctuations even further. Developing countries can draw on the IMF's compensatory financing scheme or the EC's Stabex system. If so desired, these mechanisms could certainly be improved. They could even serve as a model for domestic schemes of income averaging.

On the Proposal's Realism

Whether a proposal has a realistic chance of being adopted during the Uruguay Round depends ultimately on its ability to garner enough domestic political support in the major trading nations. It has already been argued at some length in this report that domestic acceptability hinges on a favorable political constellation. It is particularly important that the political power of the groups that stand to lose from a trade reform proposal in the short run be kept in check by a sufficient amount of countervailing power. This means there have to be other special interest groups, apart from consumers, that are strongly in favor of a trade reform and, at the same time, have enough political clout to counter the influence of those groups that oppose the reform.

The influence of special interest groups on the negotiations is greatly increased by sector-specific, commodity-based reform proposals that lead to piecemeal trade arrangements one commodity at a time. Negotiations on this basis are likely to break down or lead the agricultural sector closer to a system of managed trade. The political power needed to counter these special interest groups can be generated to some extent by the aggregate negotiating approach advocated by the United States in the Negotiating Group on Agriculture. If all agricultural support programs for all commodities are negotiated in one package, it is at least possible to trade a country's losses in one commodity group, such as oilseeds, for gains in another commodity group, such as grains. The political influence of a commodity group that is losing can be counteracted by the influence of a commodity group that stands to gain. However, this negotiating approach runs into a problem with countries such as Japan, the Nordic countries, and the EC, which have few or no commodity groups that would gain from a given reform package. This can be solved by negotiating not only agriculture, but all sectors, in one package. Losses in agriculture can thus be compensated for by gains in industry, or vice versa,[77] and countervailing power is established across sectors and industries. But negotiations across sectors require a unifying principle just as a package deal in agriculture alone needs a unifying negotiating and measurement concept like PSE. Tariffication as defined above, applicable for all sectors and fully compatible with the basic principles of the GATT, could be this unifying theme.

If the negotiations of the Uruguay Round extend across sectors and are based on the idea of tariffication, then their success depends on whether it is possible to find an overall balance of gains and losses for the major trading nations—the United States, the EC, Japan, and the Cairns Group countries. In the remainder of this chapter some of these possible gains and losses are outlined to show that the Uruguay Round could indeed reach an overall agreement. The discussion will center on agriculture.

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[77] Australia, for example, is a country where protection in industry could be more easily reduced if industry were negotiated in a package deal with agriculture, which can expect to gain significantly from a trade reform that opens up domestic markets in all countries.

The trade reform proposal outlined above would mean considerable adjustment pressure for the farmers of countries that are importers of agricultural products but have significant frontier barriers. Japan and the Nordic countries fall into this category. The suggested ban on agricultural export subsidies is probably the least controversial part of the proposal, because export subsidies are used seldom or not at all. Japan, for example, employs export subsidies for rice only sporadically, hence their elimination would not cause much political resistance from farming groups. This is reflected in the trade reform proposals that Japan and the Nordic countries tabled in the Negotiating Group on Agriculture in 1987.

Comprehensive tariffication, including uniformity of tariffs and the dismantling of state trading, poses much more of a threat to farmers in these countries because it would require a substantive restructuring of domestic support policies. The incomes of certain sections of the agricultural sector, that is, producers of particular crops or firms upstream or downstream of agricultural producers, could shrink as a result. Expected income losses, however, or simply uncertainty about future income will cause resistance to reform ideas in the farm community. As there is little or nothing for Japan and the Nordic countries to request as compensation from their trading partners in the area of agriculture, the agricultural sector will be solidly united against reform. Plenty of compensation possibilities exist, however, outside of agriculture. Japanese cars, electronics, and other manufactures, for example, face numerous nontariff barriers in the United States, Australasia, and many developing countries that are actual or potential exporters of agricultural products to Japan. A cross-sectoral reform package that promises new opportunities for industry, balanced by concessions in agriculture, could be of sufficient interest to industry to take on the farm lobby and hence to allow the government some room for compromise at the multilateral trade negotiations.

The case of the EC differs somewhat from that of Japan or the Nordic countries because it is a large and growing net exporter of agricultural products. As export subsidies are an integral part of the Common Agricultural Policy, the EC could and does assert that a ban on export subsidies would be equivalent to fundamentally changing the nature of its internal agricultural policy regime, whereas this would apply to no other country to that extent. In addition, comprehensive tariffication would mean an end to the system of variable levies, another keystone of the Common Agricultural Policy. Hence it seems clear that marginal adjustments of the type implemented by the Common Agricultural Policy in past years would not suffice this time. (The introduction of coresponsibility levies for milk, production quotas for sugar, and decreasing market price support for cereals are examples of these adjustments.)

In order to maintain the incomes of farmers, the Common Agricultural Policy would probably have to be changed over to a system based on direct income support or deficiency payments, possibly along the lines of a combination of production controls and marketing certificates, as outlined in Chapter 5. Although this might not necessarily lower the incomes of farmers in the short run (Koester and Nuppenau 1987), it would certainly cause considerable uncertainty among farmers. In addition, there would be adjustment costs for many vested interests with strong links to farm production. For example, landowners would incur capital losses and the industries upstream and downstream of agricultural production would face a structural adjustment problem, with income losses highly probable in the short to medium run.

Even if certain commodity groups within agriculture could gain from a trade reform as suggested above, it is far from clear who would gain in the end. The many complex distortions introduced by the Common Agricultural Policy make any predictions highly uncertain. Given this high degree of uncertainty, it is unlikely that much support for trade reform will be forthcoming from agriculture. The political power of those groups with a strong vested interest in the status quo can be counteracted only with sufficient pressure from outside of agriculture. In this sense, the situation in the EC is not very different from that in Japan and the Nordic countries.

In another sense, the EC differs from Japan in agriculture because trade reform, as outlined above, would give the EC something in agriculture that it has long desired, tariff harmonization. It has to be remembered in this context that tariffication, as defined above, rests on relatively low base tariffs that are uniform within broad commodity groups. (The base tariffs will prevail after an adjustment period during which countries will use excess tariffs according to a revised safeguard Article XIX to ease the transition to the new system based solely on tariffs.) Uniformity of tariffs is a means of minimizing distortions that are generated by differences in effective protection rates; thus it removes one strong incentive for domestic subsidies. For example, even without changing the current system of the Common Agricultural Policy, there would be no EC subsidy program for oilseeds if the EC could raise the tariffs for oilseeds and the feed substitutes manioc (cassava), corn gluten, and citrus pellets from close to zero to a level that matches the protection level for grains. (This is not to say that harmonizing protection levels for feed substitutes upward to the level currently pertaining to grains is, per se, a good idea.)

Harmonization of EC tariffs would have considerable effects on other countries, even if the uniform base tariffs were fixed at a level much lower than those rates of protection now common for most agricultural commodities produced by the EC. Strong opposition by the oilseed and feed-substitute commodity groups would have to be overcome in the United States, Thailand, Argentina, and Brazil, to name only a few countries. Comprehensive tariffication, then, if applied to the EC case, clearly invalidates the argument that only the EC—not the United States—would have to accede in agriculture.

Is there anything worthwhile that the United States and other affected countries would gain from uniform base tariffs in the EC? If the answer is yes, there is a chance that sufficient countervailing power can develop against the strong opposition of those commodity groups that stand to lose. Before turning to the various repercussions of tariff harmonization, though, it seems worthwhile to mention briefly a basic point relating to negotiation strategy.

In the absence of some form of tariff harmonization, the EC is not going to let the feed-substitute issue rest in peace. The budgetary pressure is simply too high. Domestic subsidies will continue, and production will increase and gradually displace a growing quantity of imports. Countries with less political and economic power than the United States, such as Thailand, will have to cut back their exports because of tighter voluntary export restraints. (The EC has already concluded a voluntary export restraint on manioc with Thailand that reduced Thai exports to the EC from about 8 million tons to 5 million tons.) What all this means is that the economic value of the zero-tariff binding for feed substitutes will diminish over time. (This fear is behind the U.S. initiative to bring the feed subsidies of the EC before a GATT panel.) If present trends continue, its economic value is likely to be zero in a few years, unless two unknowns are assumed: a clear decision by a GATT panel against the EC oilseed subsidy program and the willingness of the EC to abide by it.

The basic idea of tariffication is that relatively low uniform tariffs replace the current system of protection after some period of adjustment. Lower rates of protection in the EC for all agricultural products and the absence of export subsidies will mean much better market conditions for many traded commodities, particularly grains, beef, and sugar. The keystone commodity group for U.S. agriculture consists of grains. Better market conditions here are likely to translate into considerable political support for trade reform that could more than compensate for the negative attitude of feed-substitute and oilseed producers.

It is certain that the producers of feed substitutes and oilseeds are going to lose from tariffication. It would mean an end to the rents they now receive by being able to sell at zero duty in the EC market that is otherwise highly protected. The following changes can be anticipated. The drop in the price of citrus pellets would lower, ceteris paribus, the profits of the producers of citrus juices and its derivatives. However, since tariffication would also mean lower frontier barriers for the latter products, particularly in Japan, the benefits of an expanding market would probably compensate for the drop in profits resulting from higher production costs.

The virtual loss of the corn gluten market in the EC would raise the production costs of the wet-corn milling industry in the United States, thereby pushing down profits on high-fructose sweeteners, ethanol, and a range of other products made from corn. A further drop in profits would result from the likely world price increase in corn, the industry's basic input. As tariffication would also end U.S. quotas on sugar, the U.S. sugar price would fall considerably. Since sugar is the industry's basic competing product, corn sweetener production would become even less profitable. As a result, sugar might regain some of its lost ground or at least not lose much more in the United States because of trade reform.

Lower prices for all feed substitutes relative to coarse grains might displace some grain from use for feed. Hence the production costs in the United States for pork, poultry, beef, and dairy products might not go up, despite a likely price increase in grains, so there would not be a squeeze on profits from the cost side. Lower protection rates on dairy products, however, could reduce profits from the output side.

High protection rates on feedgrains, together with zero-tariff bindings on feed substitutes in the EC, have made Thailand a large exporter to the EC of the feedgrain substitute manioc. Similarly, Brazil and Argentina supply oilseed meals to the EC. Tariff harmonization in the EC would mean sharply reduced EC imports of both types of feeds. As this translates into immediate income losses for feed-substitute producers in these countries, the question of compensation becomes of crucial importance. Internal support for a trade reform based on tariffication can be mobilized only if large enough gains through better market access can be expected in other products, inside or outside of agriculture. Such gains are indeed very likely. Better export opportunities, in both the EC and third markets, are certain in a number of products that are both heavily subsidized by the EC and of particular interest to Argentina, Brazil, and Thailand. These products are grains for Argentina, beef for Argentina and Brazil, and sugar for Brazil, to name only the most important agricultural products. Apart from that, tariffication would translate into better market access for textiles and clothing for both Brazil and Thailand. Thailand could also expect to benefit in other products. Since tariffication also applies to the United States and Japan, Thai rice producers could expect significant gains, as the United States would stop subsidizing its rice exports and Japan would lower its barriers for rice imports.[78]

In short, those countries that are negatively affected by tariff harmonization between grains and grain substitutes in the EC would be expected to get sizable economic benefits from tariffication. As the economic gains would be reaped to a large extent by agricultural commodity groups with considerable domestic clout, it is unlikely that comprehensive tariffication will fail because of the opposition of producers of feedgrain substitutes.

Comprehensive tariffication, however, would also affect other commodity groups. In particular, it would imply that the trade preferences the EC is granting under the Lomé Agreement to ACP countries would lose much of their value. This issue was examined at some length earlier, hence it is sufficient to point out here the similarity between ACP tariff preferences and the zero-tariff binding for feedgrain substitutes. Tariffication would mean an end to quota rents in both cases. But as all countries switch to tariffication, export opportunities open up in other markets, not only in the particular product where quota rents are lost, but in general. Export opportunities are likely to improve, not worsen, when market access in selected products and countries is exchanged for improved market access in all products and all countries. This point applies not only to developing countries that fear for their quota rents, but with equal force to others that think tariff increases due to tariffication (tariff harmonization) will do them more harm than good. In this context, it should be remembered that low tariffs alone do not guarantee market access. Seasonal quotas, tariff quotas, and a host of other schemes are currently used to nullify low tariffs. The idea of tariffication is to eliminate these import barriers and along with them the high degree of uncertainty about market access.

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[78] The Japanese rice policy is analyzed in Otsuka and Hayami 1985. The world rice market and Thailand's role in it is detailed in Siamwalla and Haykin 1983.

A switch to a tariffs-only system would require significant adjustments in the agricultural sector of the United States that would extend far beyond the structural adjustment problems faced by oilseed producers mentioned above. For example, export subsidies would have to stop. Since the 1985 U.S. Farm Bill was passed, export subsidies have been used for numerous commodities ranging from beef and dairy to grains, although not to the extent common in the EC (see cases cited in Chapter 5). Further, the current system of deficiency payments, by which payments are made for all production regardless of domestic or export use, would have to be revised. Seasonal import restrictions on fruit and vegetables would have to be phased out. Above all, the section 22 waiver, granting the right to impose quotas at will without compensation, would have to be given up by the United States and would affect beef, sugar, and dairy producers. It is unlikely that they will be easily convinced of the merits of trade reform. However, the lobby that is in favor of trade reform can be expected to be strong in the United States. Within agriculture, grain producers can be counted on for support because their potential gains from worldwide tariffication are the most obvious. The strongest support for trade reform, however, is likely to come from outside of agriculture, that is, from industry and the services. The concessions in agriculture—tariff harmonization and the elimination of the section 22 waiver—could be used to obtain compensating concessions in areas outside of agriculture. In practice, this would mean that LDCs compromise in industrial goods, intellectual property rights, trade-related investment measures, and services.[79] It would also imply a commitment by the Cairns Group countries (particularly Australasia), which gain from trade reform in agriculture more than any other country or country group, to open up their markets for industrial goods and services.

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[79] The willingness of LDCs and, in particular, the newly industrialized countries to compromise in these areas could be reinforced considerably if the United States as well as all other industrial countries could agree to extend tariffication unconditionally to light industries such as textiles and clothing, that is, industries that are of particular interest to LDCs.

APPENDIX 1: SELECTED ARTICLES OF THE GENERAL AGREEMENT

Article VI

Anti-dumping and Countervailing Duties

1. The contracting parties recognize that dumping, by which products of one country are introduced into the commerce of another country at less than the normal value of the products, is to be condemned if it causes or threatens material injury to an established industry in the territory of a contracting party or materially retards the establishment of a domestic industry. For the purposes of this Article, a product is to be considered as being introduced into the commerce of an importing country at less than its normal value, if the price of the product exported from one country to another

(*a*) is less than the comparable price, in the ordinary course of trade, for the like product when destined for consumption in the exporting country, or,

(*b*) in the absence of such domestic price, is less than either

  (i) the highest comparable price for the like product for export to any third country in the ordinary course of trade, or

  (ii) the cost of production of the product in the country of origin plus a reasonable addition for selling cost and profit.

Due allowance shall be made in each case for differences in conditions and terms of sale, for differences in taxation, and for other differences affecting price comparability.*

2. In order to offset or prevent dumping, a contracting party may levy on any dumped product an anti-dumping duty not greater in amount than the margin of dumping in respect of such product. For the purposes of this Article, the margin of dumping is the price difference determined in accordance with the provisions of paragraph 1.*

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* refers to interpretative notes at the end of this appendix.

3. No countervailing duty shall be levied on any product of the territory of any contracting party imported into the territory of another contracting party in excess of an amount equal to the estimated bounty or subsidy determined to have been granted, directly or indirectly, on the manufacture, production or export of such product in the country of origin or exportation, including any special subsidy to the transportation of a particular product. The term " countervailing duty " shall be understood to mean a special duty levied for the purpose of offsetting any bounty or subsidy bestowed, directly or indirectly, upon the manufacture, production or export of any merchandise.*

4. No product of the territory of any contracting party imported into the territory of any other contracting party shall be subject to anti-dumping or countervailing duty by reason of the exemption of such product from duties or taxes borne by the like product when destined for consumption in the country of origin or exportation, or by reason of the refund of such duties or taxes.

5. No product of the territory of any contracting party imported into the territory of any other contracting party shall be subject to both anti-dumping and countervailing duties to compensate for the same situation of dumping or export subsidization.

6. (*a*) No contracting party shall levy any anti-dumping or countervailing duty on the importation of any product of the territory of another contracting party unless it determines that the effect of the dumping or subsidization, as the case may be, is such as to cause or threaten material injury to an established domestic industry, or is such as to retard materially the establishment of a domestic industry.

(*b*) The CONTRACTING PARTIES may waive the requirement of sub-paragraph (*a*) of this paragraph so as to permit a contracting party to levy an anti-dumping or countervailing duty on the importation of any product for the purpose of offsetting dumping or subsidization which causes or threatens material injury to an industry in the territory of another contracting party exporting the product concerned to the territory of the importing contracting party. The CONTRACTING PARTIES shall waive the requirements of sub-paragraph (*a*) of this paragraph, so as to permit the levying of a countervailing duty, in cases in which they find that a subsidy is causing or threatening material injury to an industry in the territory of another contracting party exporting the product concerned to the territory of the importing contracting party.*

(*c*) In exceptional circumstances, however, where delay might cause damage which would be difficult to repair, a contracting party may levy a countervailing duty for the purpose referred to in sub-paragraph (*b*) of this paragraph without the prior approval of the CONTRACTING PARTIES; *Provided* that such action shall be reported immediately to the CONTRACTING PARTIES and that the countervailing duty shall be withdrawn promptly if the CONTRACTING PARTIES disapprove.

7. A system for the stabilization of the domestic price or of the return to domestic producers of a primary commodity, independently of the movements of export prices, which results at times in the sale of the commodity for export at a price lower than the comparable price charged for the like commodity to buyers in the domestic market, shall be presumed not to result in material injury within the meaning of paragraph 6 if it is determined by consultation among the contracting parties substantially interested in the commodity concerned that:

(*a*) the system has also resulted in the sale of the commodity for export at a price higher than the comparable price charged for the like commodity to buyers in the domestic market, and

(*b*) the system is so operated, either because of the effective regulation of production, or otherwise, as not to stimulate exports unduly or otherwise seriously prejudice the interests of other contracting parties.

Article XI *

General Elimination of Quantitative Restrictions

1. No prohibitions or restrictions other than duties, taxes or other charges, whether made effective through quotas, import or export licences or other measures, shall be instituted or maintained by any contracting party on the importation of any product of the territory of any other contracting party or on the exportation or sale for export of any product destined for the territory of any other contracting party.

2. The provisions of paragraph 1 of this Article shall not extend to the following:

(*a*) Export prohibitions or restrictions temporarily applied to prevent or relieve critical shortages of foodstuffs or other products essential to the exporting contracting party;

(*b*) Import and export prohibitions or restrictions necessary to the application of standards or regulations for the classification, grading or marketing of commodities in international trade;

(*c*) Import restrictions on any agricultural or fisheries product, imported in any form,* necessary to the enforcement of governmental measures which operate:

  (i) to restrict the quantities of the like domestic product permitted to be marketed or produced, or, if there is no substantial domestic production of the like product, of a domestic product for which the imported product can be directly substituted; or

  (ii) to remove a temporary surplus of the like domestic product, or, if there is no substantial domestic production of the like product, of a domestic product for which the imported product can be directly substituted, by making the surplus available to certain groups of domestic consumers free of charge or at prices below the current market level; or

  (iii) to restrict the quantities permitted to be produced of any animal product the production of which is directly dependent, wholly or mainly, on the imported commodity, if the domestic production of that commodity is relatively negligible.

Any contracting party applying restrictions on the importation of any product pursuant to sub-paragraph (*c*) of this paragraph shall give public notice of the total quantity or value of the product permitted to be imported during a specified future period and of any change in such quantity or value. Moreover, any restrictions applied under (i) above shall not be such as will reduce the total of imports relative to the total of domestic production, as compared with the proportion which might reasonably be expected to rule between the two in the absence of restrictions. In determining this proportion, the contracting party shall pay due regard to the proportion prevailing during a previous representative period and to any special factors* which may have affected or may be affecting the trade in the product concerned.

Article XIII *

Non-discriminatory Administration of Quantitative Restrictions

1. No prohibition or restriction shall be applied by any contracting party on the importation of any product of the territory of any other

contracting party or on the exportation of any product destined for the territory of any other contracting party, unless the importation of the like product of all third countries or the exportation of the like product to all third countries is similarly prohibited or restricted.

2. In applying import restrictions to any product, contracting parties shall aim at a distribution of trade in such product approaching as closely as possible the shares which the various contracting parties might be expected to obtain in the absence of such restrictions, and to this end shall observe the following provisions:

(*a*) Wherever practicable, quotas representing the total amount of permitted imports (whether allocated among supplying countries or not) shall be fixed, and notice given of their amount in accordance with paragraph 3 (*b*) of this Article;

(*b*) In cases in which quotas are not practicable, the restrictions may be applied by means of import licences or permits without a quota;

(*c*) Contracting parties shall not, except for purposes of operating quotas allocated in accordance with sub-paragraph (*d*) of this paragraph, require that import licences or permits be utilized for the importation of the product concerned from a particular country or source;

(*d*) In cases in which a quota is allocated among supplying countries, the contracting party applying the restrictions may seek agreement with respect to the allocation of shares in the quota with all other contracting parties having a substantial interest in supplying the product concerned. In cases in which this method is not reasonably practicable, the contracting party concerned shall allot to contracting parties having a substantial interest in supplying the product shares based upon the proportions, supplied by such contracting parties during a previous representative period, of the total quantity or value of imports of the product, due account being taken of any special factors which may have affected or may be affecting the trade in the product. No conditions or formalities shall be imposed which would prevent any contracting party from utilizing fully the share of any such total quantity or value which has been allotted to it, subject to importation being made within any prescribed period to which the quota may relate.*

3. (*a*) In cases in which import licences are issued in connection with import restrictions, the contracting party applying the restrictions shall provide, upon the request of any contracting party having an interest in

the trade in the product concerned, all relevant information concerning the administration of the restrictions, the import licences granted over a recent period and the distribution of such licences among supplying countries; *Provided* that there shall be no obligation to supply information as to the names of importing or supplying enterprises.

(*b*) In the case of import restrictions involving the fixing of quotas, the contracting party applying the restrictions shall give public notice of the total quantity or value of the product or products which will be permitted to be imported during a specified future period and of any change in such quantity or value. Any supplies of the product in question which were *en route* at the time at which public notice was given shall not be excluded from entry; *Provided* that they may be counted so far as practicable, against the quantity permitted to be imported in the period in question, and also, where necessary, against the quantities permitted to be imported in the next following period or periods; and *Provided* further that if any contracting party customarily exempts from such restrictions products entered for consumption or withdrawn from warehouse for consumption during a period of thirty days after the day of such public notice, such practice shall be considered full compliance with this sub-paragraph.

(*c*) In the case of quotas allocated among supplying countries, the contracting party applying the restrictions shall promptly inform all other contracting parties having an interest in supplying the product concerned of the shares in the quota currently allocated, by quantity or value, to the various supplying countries and shall give public notice thereof.

4. With regard to restrictions applied in accordance with paragraph 2 (*d*) of this Article or under paragraph 2 (*c*) of Article XI, the selection of a representative period for any product and the appraisal of any special factors * affecting the trade in the product shall be made initially by the contracting party applying the restriction; *Provided* that such contracting party shall, upon the request of any other contracting party having a substantial interest in supplying that product or upon the request of the CONTRACTING PARTIES, consult promptly with the other contracting party or the CONTRACTING PARTIES regarding the need for an adjustment of the proportion determined or of the base period selected, or for the reappraisal of the special factors involved, or for the elimination of conditions, formalities or any other provisions established unilaterally relating to the allocation of an adequate quota or its unrestricted utilization.

5. The provisions of this Article shall apply to any tariff quota instituted or maintained by any contracting party, and, in so far as applicable, the principles of this Article shall also extend to export restrictions.

Article XVI *

Subsidies

Section A—Subsidies in General

1. If any contracting party grants or maintains any subsidy, including any form of income or price support, which operates directly or indirectly to increase exports of any product from, or to reduce imports of any product into, its territory, it shall notify the CONTRACTING PARTIES in writing of the extent and nature of the subsidization, of the estimated effect of the subsidization on the quantity of the affected product or products imported into or exported from its territory and of the circumstances making the subsidization necessary. In any case in which it is determined that serious prejudice to the interests of any other contracting party is caused or threatened by any such subsidization, the contracting party granting the subsidy shall, upon request, discuss with the other contracting party or parties concerned, or with the CONTRACTING PARTIES, the possibility of limiting the subsidization.

Section B—Additional Provisions on Export Subsidies *

2. The contracting parties recognize that the granting by a contracting party of a subsidy on the export of any product may have harmful effects for other contracting parties, both importing and exporting, may cause undue disturbance to their normal commercial interests, and may hinder the achievement of the objectives of this Agreement.

3. Accordingly, contracting parties should seek to avoid the use of subsidies on the export of primary products. If, however, a contracting party grants directly or indirectly any form of subsidy which operates to increase the export of any primary product from its territory, such subsidy shall not be applied in a manner which results in that contracting party having more than an equitable share of world export trade in that product, account being taken of the shares of the contracting parties in such trade in the product during a previous representative period, and any special factors which may have affected or may be affecting such trade in the product.*

4. Further, as from 1 January 1958 or the earliest practicable date thereafter, contracting parties shall cease to grant either directly or indirectly any form of subsidy on the export of any product other than a primary product which subsidy results in the sale of such product for export

at a price lower than the comparable price charged for the like product to buyers in the domestic market. Until 31 December 1957 no contracting party shall extend the scope of any such subsidization beyond that existing on 1 January 1955 by the introduction of new, or the extension of existing, subsidies.*

5. The CONTRACTING PARTIES shall review the operation of the provisions of this Article from time to time with a view to examining its effectiveness, in the light of actual experience, in promoting the objectives of this Agreement and avoiding subsidization seriously prejudicial to the trade or interests of contracting parties.

Article XVII

State Trading Enterprises

1.* (*a*) Each contracting party undertakes that if it establishes or maintains a State enterprise, wherever located, or grants to any enterprise, formally or in effect, exclusive or special privileges,* such enterprise shall, in its purchases or sales involving either imports or exports, act in a manner consistent with the general principles of non-discriminatory treatment prescribed in this Agreement for governmental measures affecting imports or exports by private traders.

(*b*) The provisions of sub-paragraph (*a*) of this paragraph shall be understood to require that such enterprises shall, having due regard to the other provisions of this Agreement, make any such purchases or sales solely in accordance with commercial considerations,* including price, quality, availability, marketability, transportation and other conditions of purchase or sale, and shall afford the enterprises of the other contracting parties adequate opportunity, in accordance with customary business practice, to compete for participation in such purchases or sales.

(*c*) No contracting party shall prevent any enterprise (whether or not an enterprise described in sub-paragraph (*a*) of this paragraph) under its jurisdiction from acting in accordance with the principles of sub-paragraphs (*a*) and (*b*) of this paragraph.

2. The provisions of paragraph 1 of this Article shall not apply to imports of products for immediate or ultimate consumption in governmental use and not otherwise for resale or use in the production of goods * for sale. With respect to such imports, each contracting party shall accord to the trade of the other contracting parties fair and equitable treatment.

3. The contracting parties recognize that enterprises of the kind described in paragraph 1 (*a*) of this Article might be operated so as to create serious obstacles to trade; thus negotiations on a reciprocal and mutually advantageous basis designed to limit or reduce such obstacles are of importance to the expansion of international trade.*

4. (*a*) Contracting parties shall notify the CONTRACTING PARTIES of the products which are imported into or exported from their territories by enterprises of the kind described in paragraph 1 (*a*) of this Article.

(*b*) A contracting party establishing, maintaining or authorizing an import monopoly of a product, which is not the subject of a concession under Article II, shall, on the request of another contracting party having a substantial trade in the product concerned, inform the CONTRACTING PARTIES of the import mark-up * on the product during a recent representative period, or, when it is not possible to do so, of the price charged on the resale of the product.

(*c*) The CONTRACTING PARTIES may, at the request of a contracting party which has reason to believe that its interests under this Agreement are being adversely affected by the operations of an enterprise of the kind described in paragraph 1 (*a*), request the contracting party establishing, maintaining or authorizing such enterprise to supply information about its operations related to the carrying out of the provisions of this Agreement.

(*d*) The provisions of this paragraph shall not require any contracting party to disclose confidential information which would impede law enforcement or otherwise be contrary to the public interest or would prejudice the legitimate commercial interests of particular enterprises.

Article XIX

Emergency Action on Imports of Particular Products

1. (*a*) If, as a result of unforeseen developments and of the effect of the obligations incurred by a contracting party under this Agreement, including tariff concessions, any product is being imported into the territory of that contracting party in such increased quantities and under such conditions as to cause or threaten serious injury to domestic producers in that territory of like or directly competitive products, the contracting party shall be free, in respect of such product, and to the extent and for such time as may be necessary to prevent or remedy such injury, to suspend the obligation in whole or in part or to withdraw or modify the concession.

(*b*) If any product, which is the subject of a concession with respect to a preference, is being imported into the territory of a contracting party in the circumstances set forth in sub-paragraph (*a*) of this paragraph, so as to cause or threaten serious injury to domestic producers of like or directly competitive products in the territory of a contracting party which receives or received such preference, the importing contracting party shall be free, if that other contracting party so requests, to suspend the relevant obligation in whole or in part or to withdraw or modify the concession in respect of the product, to the extent and for such time as may be necessary to prevent or remedy such injury.

2. Before any contracting party shall take action pursuant to the provisions of paragraph 1 of this Article, it shall give notice in writing to the CONTRACTING PARTIES as far in advance as may be practicable and shall afford the CONTRACTING PARTIES and those contracting parties having a substantial interest as exporters of the product concerned an opportunity to consult with it in respect of the proposed action. When such notice is given in relation to a concession with respect to a preference, the notice shall name the contracting party which has requested the action. In critical circumstances, where delay would cause damage which it would be difficult to repair, action under paragraph 1 of this Article may be taken provisionally without prior consultation, on the condition that consultation shall be effected immediately after taking such action.

3. (*a*) If agreement among the interested contracting parties with respect to the action is not reached, the contracting party which proposes to take or continue the action shall, nevertheless, be free to do so, and if such action is taken or continued, the affected contracting parties shall then be free, not later than ninety days after such action is taken, to suspend, upon the expiration of thirty days from the day on which written notice of such suspension is received by the CONTRACTING PARTIES, the application to the trade of the contracting party taking such action, or, in the case envisaged in paragraph 1 (*b*) of this Article, to the trade of the contracting party requesting such action, of such substantially equivalent concessions or other obligations under this Agreement the suspension of which the CONTRACTING PARTIES do not disapprove.

(*b*) Notwithstanding the provisions of sub-paragraph (*a*) of this paragraph, where action is taken under paragraph 2 of this Article without prior consultation and causes or threatens serious injury in the territory of a contracting party to the domestic producers of products affected by the action, that contracting party shall, where delay would cause damage difficult to repair, be free to suspend, upon the taking of the action and throughout the period of consultation, such concessions or other obligations as may be necessary to prevent or remedy the injury.

Article XX

General Exceptions

Subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade, nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures:

(*a*) necessary to protect public morals;

(*b*) necessary to protect human, animal or plant life or health;

(*c*) relating to the importation or exportation of gold or silver;

(*d*) necessary to secure compliance with laws or regulations which are not inconsistent with the provisions of this Agreement, including those relating to customs enforcement, the enforcement of monopolies operated under paragraph 4 of Article II and Article XVII, the protection of patents, trade marks and copyrights, and the prevention of deceptive practices;

(*e*) relating to the products of prison labour;

(*f*) imposed for the protection of national treasures of artistic, historic or archaeological value;

(*g*) relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption;

(*h*) undertaken in pursuance of obligations under any intergovernmental commodity agreement which conforms to criteria submitted to the CONTRACTING PARTIES and not disapproved by them or which is itself so submitted and not so disapproved;*

(*i*) involving restrictions on exports of domestic materials necessary to ensure essential quantities of such materials to a domestic processing industry during periods when the domestic price of such materials is held below the world price as part of a governmental stabilization plan; *Provided* that such restrictions shall not operate to increase the exports of or the protection afforded to such domestic industry, and shall not depart from the provisions of this Agreement relating to non-discrimination;

(*j*) essential to the acquisition or distribution of products in general or local short supply; *Provided* that any such measures shall be consistent with the principle that all contracting parties are entitled to an equitable share of the international supply of such products, and that any such measures, which are inconsistent with the other provisions of this Agreement shall be discontinued as soon as the conditions giving rise to them have ceased to exist. The CONTRACTING PARTIES shall review the need for this sub-paragraph not later than 30 June 1960.

Article XXII

Consultation

1. Each contracting party shall accord sympathetic consideration to, and shall afford adequate opportunity for consultation regarding, such representations as may be made by another contracting party with respect to any matter affecting the operation of this Agreement.

2. The CONTRACTING PARTIES may, at the request of a contracting party, consult with any contracting party or parties in respect of any matter for which it has not been possible to find a satisfactory solution through consultation under paragraph 1.

Article XXIII

Nullification or Impairment

1. If any contracting party should consider that any benefit accruing to it directly or indirectly under this Agreement is being nullified or impaired or that the attainment of any objective of the Agreement is being impeded as the result of

(*a*) the failure of another contracting party to carry out its obligations under this Agreement, or

(*b*) the application by another contracting party of any measure, whether or not it conflicts with the provisions of this Agreement, or

(*c*) the existence of any other situation,

the contracting party may, with a view to the satisfactory adjustment of the matter, make written representations or proposals to the other contracting party or parties which it considers to be concerned. Any contracting party thus approached shall give sympathetic consideration to the representations or proposals made to it.

2. If no satisfactory adjustment is effected between the contracting parties concerned within a reasonable time, or if the difficulty is of the type described in paragraph 1 (c) of this Article, the matter may be referred to the CONTRACTING PARTIES. The CONTRACTING PARTIES shall promptly investigate any matter so referred to them and shall make appropriate recommendations to the contracting parties which they consider to be concerned, or give a ruling on the matter, as appropriate. The CONTRACTING PARTIES may consult with contracting parties, with the Economic and Social Council of the United Nations and with any appropriate inter-governmental organization in cases where they consider such consultation necessary. If the CONTRACTING PARTIES consider that the circumstances are serious enough to justify such action, they may authorize a contracting party or parties to suspend the application to any other contracting party or parties of such concessions or other obligations under this Agreement as they determine to be appropriate in the circumstances. If the application to any contracting party of any concession or other obligation is in fact suspended, that contracting party shall then be free, not later than sixty days after such action is taken, to give written notice to the Executive Secretary[1] to the CONTRACTING PARTIES of its intention to withdraw from this Agreement and such withdrawal shall take effect upon the sixtieth day following the day on which such notice is received by him.

Article XXVIII *

Modification of Schedules

1. On the first day of each three-year period, the first period beginning on 1 January 1958 (or on the first day of any other period * that may be specified by the CONTRACTING PARTIES by two-thirds of the votes cast) a contracting party (hereafter in this Article referred to as the "applicant contracting party") may, by negotiation and agreement with any contracting party with which such concession was initially negotiated and with any other contracting party determined by the CONTRACTING PARTIES to have a principal supplying interest* (which two preceding categories of contracting

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[1] Since changed to Director-General.

parties, together with the applicant contracting party, are in this Article hereinafter referred to as the "contracting parties primarily concerned"), and subject to consultation with any other contracting party determined by the CONTRACTING PARTIES to have a substantial interest* in such concession, modify or withdraw a concession* included in the appropriate Schedule annexed to this Agreement.

2. In such negotiations and agreement, which may include provision for compensatory adjustment with respect to other products, the contracting parties concerned shall endeavour to maintain a general level of reciprocal and mutually advantageous concessions not less favourable to trade than that provided for in this Agreement prior to such negotiations.

3. (*a*) If agreement between the contracting parties primarily concerned cannot be reached before 1 January 1958 or before the expiration of a period envisaged in paragraph 1 of this Article, the contracting party which proposes to modify or withdraw the concession shall, nevertheless, be free to do so and if such action is taken any contracting party with which such concession was initially negotiated, any contracting party determined under paragraph 1 to have a principal supplying interest and any contracting party determined under paragraph 1 to have a substantial interest shall then be free not later than six months after such action is taken, to withdraw, upon the expiration of thirty days from the day on which written notice of such withdrawal is received by the CONTRACTING PARTIES, substantially equivalent concessions initially negotiated with the applicant contracting party.

(*b*) If agreement between the contracting parties primarily concerned is reached but any other contracting party determined under paragraph 1 of this Article to have a substantial interest is not satisfied, such other contracting party shall be free, not later than six months after action under such agreement is taken, to withdraw, upon the expiration of thirty days from the day on which written notice of such withdrawal is received by the CONTRACTING PARTIES, substantially equivalent concessions initially negotiated with the applicant contracting party.

4. The CONTRACTING PARTIES may, at any time, in special circumstances, authorize* a contracting party to enter into negotiations for modification or withdrawal of a concession included in the appropriate Schedule annexed to this Agreement subject to the following procedures and conditions:

(*a*) Such negotiations* and any related consultations shall be conducted in accordance with the provisions of paragraphs 1 and 2 of this Article.

(*b*) If agreement between the contracting parties primarily concerned is reached in the negotiations, the provisions of paragraph 3 (*b*) of this Article shall apply.

(*c*) If agreement between the contracting parties primarily concerned is not reached within a period of sixty days* after negotiations have been authorized, or within such longer period as the CONTRACTING PARTIES may have prescribed, the applicant contracting party may refer the matter to the CONTRACTING PARTIES.

(*d*) Upon such reference, the CONTRACTING PARTIES shall promptly examine the matter and submit their views to the contracting parties primarily concerned with the aim of achieving a settlement. If a settlement is reached, the provisions of paragraph 3 (*b*) shall apply as if agreement between the contracting parties primarily concerned had been reached. If no settlement is reached between the contracting parties primarily concerned, the applicant contracting party shall be free to modify or withdraw the concession, unless the CONTRACTING PARTIES determine that the applicant contracting party has unreasonably failed to offer adequate compensation.* If such action is taken, any contracting party with which the concession was initially negotiated, any contracting party determined under paragraph 4 (*a*) to have a principal supplying interest and any contracting party determined under paragraph 4 (*a*) to have a substantial interest, shall be free, not later than six months after such action is taken, to modify or withdraw, upon the expiration of thirty days from the day on which written notice of such withdrawal is received by the CONTRACTING PARTIES, substantially equivalent concessions initially negotiated with the applicant contracting party.

5. Before 1 January 1958 and before the end of any period envisaged in paragraph 1 a contracting party may elect by notifying the CONTRACTING PARTIES to reserve the right, for the duration of the next period, to modify the appropriate Schedule in accordance with the procedures of paragraphs 1 to 3. If a contracting party so elects, other contracting parties shall have the right, during the same period, to modify or withdraw, in accordance with the same procedures, concessions initially negotiated with that contracting party.

Interpretative Notes to the Articles

Ad *Article VI*

Paragraph 1

1. Hidden dumping by associated houses (that is, the sale by an importer at a price below that corresponding to the price invoiced by an exporter with whom the importer is associated, and also below the price in the exporting country) constitutes a form of price dumping with respect to which the margin of dumping may be calculated on the basis of the price at which the goods are resold by the importer.

2. It is recognized that, in the case of imports from a country which has a complete or substantially complete monopoly of its trade and where all domestic prices are fixed by the State, special difficulties may exist in determining price comparability for the purposes of paragraph 1, and in such cases importing contracting parties may find it necessary to take into account the possibility that a strict comparison with domestic prices in such a country may not always be appropriate.

Paragraphs 2 and 3

1. As in many other cases in customs administration, a contracting party may require reasonable security (bond or cash deposit) for the payment of anti-dumping or countervailing duty pending final determination of the facts in any case of suspected dumping or subsidization.

2. Multiple currency practices can in certain circumstances constitute a subsidy to exports which may be met by countervailing duties under paragraph 3 or can constitute a form of dumping by means of a partial depreciation of a country's currency which may be met by action under paragraph 2. By " multiple currency practices " is meant practices by governments or sanctioned by governments.

Paragraph 6 (b)

Waivers under the provisions of this sub-paragraph shall be granted only on application by the contracting party proposing to levy an anti-dumping or countervailing duty, as the case may be.

Ad *Articles XI, XII, XIII, XIV and XVIII*

Throughout Articles XI, XII, XIII, XIV and XVIII, the terms " import restrictions " or " export restrictions " include restrictions made effective through state-trading operations.

Ad *Article XI*

Paragraph 2 (c)

The term " in any form " in this paragraph covers the same products when in an early stage of processing and still perishable, which compete directly with the fresh product and if freely imported would tend to make the restriction on the fresh product ineffective.

Paragraph 2, last sub-paragraph

The term " special factors " includes changes in relative productive efficiency as between domestic and foreign producers, or as between different foreign producers, but not changes artificially brought about by means not permitted under the Agreement.

Ad *Article XVI*

The exemption of an exported product from duties or taxes borne by the like product when destined for domestic consumption, or the remission of such duties or taxes in amounts not in excess of those which have accrued, shall not be deemed to be a subsidy.

Section B

1. Nothing in Section B shall preclude the use by a contracting party of multiple rates of exchange in accordance with the Articles of Agreement of the International Monetary Fund.

2. For the purposes of Section B, a " primary product " is understood to be any product of farm, forest or fishery, or any mineral, in its natural form or which has undergone such processing as is customarily required to prepare it for marketing in substantial volume in international trade.

Paragraph 3

1. The fact that a contracting party has not exported the product in question during the previous representative period would not in itself preclude that contracting party from establishing its right to obtain a share of the trade in the product concerned.

2. A system for the stabilization of the domestic price or of the return to domestic producers of a primary product independently of the movements of export prices, which results at times in the sale of the product for export at a price lower than the comparable price charged for the like product to buyers in the domestic market, shall be considered not to involve a subsidy on exports within the meaning of paragraph 3 if the CONTRACTING PARTIES determine that:

(*a*) the system has also resulted, or is so designed as to result, in the sale of the product for export at a price higher than the comparable price charged for the like product to buyers in the domestic market; and

(*b*) the system is so operated, or is designed so to operate, either because of the effective regulation of production or otherwise, as not to stimulate exports unduly or otherwise seriously to prejudice the interests of other contracting parties.

Notwithstanding such determination by the CONTRACTING PARTIES, operations under such a system shall be subject to the provisions of paragraph 3 where they are wholly or partly financed out of government funds in addition to the funds collected from producers in respect of the product concerned.

Paragraph 4

The intention of paragraph 4 is that the contracting parties should seek before the end of 1957 to reach agreement to abolish all remaining subsidies as from 1 January 1958; or, failing this, to reach agreement to extend the application of the standstill until the earliest date thereafter by which they can expect to reach such agreement.

Ad *Article XVII*

Paragraph 1

The operations of Marketing Boards, which are established by contracting parties and are engaged in purchasing or selling, are subject to the provisions of sub-paragraphs (*a*) and (*b*).

The activities of Marketing Boards which are established by contracting parties and which do not purchase or sell but lay down regulations covering private trade are governed by the relevant Articles of this Agreement.

The charging by a state enterprise of different prices for its sales of a product in different markets is not precluded by the provisions of this Article, provided that such different prices are charged for commercial reasons, to meet conditions of supply and demand in export markets.

Paragraph 1 (a)

Governmental measures imposed to ensure standards of quality and efficiency in the operation of external trade, or privileges granted for the exploitation of national natural resources but which do not empower the government to exercise control over the trading activities of the enterprise in question, do not constitute " exclusive or special privileges ".

Paragraph 1 (b)

A country receiving a " tied loan " is free to take this loan into account as a " commercial consideration " when purchasing requirements abroad.

Paragraph 2

The term " goods " is limited to products as understood in commercial practice, and is not intended to include the purchase or sale of services.

Paragraph 3

Negotiations which contracting parties agree to conduct under this paragraph may be directed towards the reduction of duties and other charges on imports and exports or towards the conclusion of any other mutually satisfactory arrangement consistent with the provisions of this Agreement. (See paragraph 4 of Article II and the note to that paragraph.)

Paragraph 4 (b)

The term " import mark-up " in this paragraph shall represent the margin by which the price charged by the import monopoly for the imported product (exclusive of internal taxes within the purview of Article III, transportation, distribution, and other expenses incident to the purchase, sale or further processing, and a reasonable margin of profit) exceeds the landed cost.

Ad *Article XX*

Sub-paragraph (h)

The exception provided for in this sub-paragraph extends to any commodity agreement which conforms to the principles approved by the Economic and Social Council in its resolution 30 (IV) of 28 March 1947.

Ad *Article XXVIII*

The CONTRACTING PARTIES and each contracting party concerned should arrange to conduct the negotiations and consultations with the greatest possible secrecy in order to avoid premature disclosure of details of prospective tariff changes. The CONTRACTING PARTIES shall be informed immediately of all changes in national tariffs resulting from recourse to this Article.

Paragraph 1

1. If the CONTRACTING PARTIES specify a period other than a three-year period, a contracting party may act pursuant to paragraph 1 or paragraph 3 of

Article XXVIII on the first day following the expiration of such other period and, unless the CONTRACTING PARTIES have again specified another period, subsequent periods will be three-year periods following the expiration of such specified period.

2. The provision that on 1 January 1958, and on other days determined pursuant to paragraph 1, a contracting party "may . . . modify or withdraw a concession" means that on such day, and on the first day after the end of each period, the legal obligation of such contracting party under Article II is altered; it does not mean that the changes in its customs tariff should necessarily be made effective on that day. If a tariff change resulting from negotiations undertaken pursuant to this Article is delayed, the entry into force of any compensatory concessions may be similarly delayed.

3. Not earlier than six months, nor later than three months, prior to 1 January 1958, or to the termination date of any subsequent period, a contracting party wishing to modify or withdraw any concession embodied in the appropriate Schedule, should notify the CONTRACTING PARTIES to this effect. The CONTRACTING PARTIES shall then determine the contracting party or contracting parties with which the negotiations or consultations referred to in paragraph 1 shall take place. Any contracting party so determined shall participate in such negotiations or consultations with the applicant contracting party with the aim of reaching agreement before the end of the period. Any extension of the assured life of the Schedules shall relate to the Schedules as modified after such negotiations, in accordance with paragraphs 1, 2 and 3 of Article XXVIII. If the CONTRACTING PARTIES are arranging for multilateral tariff negotiations to take place within the period of six months before 1 January 1958, or before any other day determined pursuant to paragraph 1, they shall include in the arrangements for such negotiations suitable procedures for carrying out the negotiations referred to in this paragraph.

4. The object of providing for the participation in the negotiations of any contracting party with a principal supplying interest, in addition to any contracting party with which the concession was initially negotiated, is to ensure that a contracting party with a larger share in the trade affected by the concession than a contracting party with which the concession was initially negotiated shall have an effective opportunity to protect the contractual right which it enjoys under this Agreement. On the other hand, it is not intended that the scope of the negotiations should be such as to make negotiations and agreement under Article XXVIII unduly difficult nor to create complications in the application of this Article in the future to concessions which result from negotiations thereunder. Accordingly, the CONTRACTING PARTIES should only determine that a contracting party has a principal supplying interest if that contracting party has had, over a reasonable period of time prior to the negotiations, a larger share in the market of the applicant contracting party than a contracting party with which the concession was initially negotiated or would, in the judgment of the CONTRACTING PARTIES, have had such a share in the absence of discriminatory quantitative restrictions

maintained by the applicant contracting party. It would therefore not be appropriate for the CONTRACTING PARTIES to determine that more than one contracting party, or in those exceptional cases where there is near equality more than two contracting parties, had a principal supplying interest.

5. Notwithstanding the definition of a principal supplying interest in note 4 to paragraph 1, the CONTRACTING PARTIES may exceptionally determine that a contracting party has a principal supplying interest if the concession in question affects trade which constitutes a major part of the total exports of such contracting party.

6. It is not intended that provision for participation in the negotiations of any contracting party with a principal supplying interest, and for consultation with any contracting party having a substantial interest in the concession which the applicant contracting party is seeking to modify or withdraw, should have the effect that it should have to pay compensation or suffer retaliation greater than the withdrawal or modification sought, judged in the light of the conditions of trade at the time of the proposed withdrawal or modification, making allowance for any discriminatory quantitative restrictions maintained by the applicant contracting party.

7. The expression " substantial interest " is not capable of a precise definition and accordingly may present difficulties for the CONTRACTING PARTIES. It is, however, intended to be construed to cover only those contracting parties which have, or in the absence of discriminatory quantitative restrictions affecting their exports could reasonably be expected to have, a significant share in the market of the contracting party seeking to modify or withdraw the concession.

Paragraph 4

1. Any request for authorization to enter into negotiations shall be accompanied by all relevant statistical and other data. A decision on such request shall be made within thirty days of its submission.

2. It is recognized that to permit certain contracting parties, depending in large measure on a relatively small number of primary commodities and relying on the tariff as an important aid for furthering diversification of their economies or as an important source of revenue, normally to negotiate for the modification or withdrawal of concessions only under paragraph 1 of Article XXVIII, might cause them at such a time to make modifications or withdrawals which in the long run would prove unnecessary. To avoid such a situation the CONTRACTING PARTIES shall authorize any such contracting party, under paragraph 4, to enter into negotiations unless they consider this would result in, or contribute substantially towards, such an increase in tariff levels as to threaten the stability of the Schedules to this Agreement or lead to undue disturbance of international trade.

3. It is expected that negotiations authorized under paragraph 4 for modification or withdrawal of a single item, or a very small group of items, could normally be brought to a conclusion in sixty days. It is recognized, however, that such a period will be inadequate for cases involving negotiations for the modification or withdrawal of a larger number of items and in such cases, therefore, it would be appropriate for the CONTRACTING PARTIES to prescribe a longer period.

4. The determination referred to in paragraph 4 (*d*) shall be made by the CONTRACTING PARTIES within thirty days of the submission of the matter to them, unless the applicant contracting party agrees to a longer period.

5. In determining under paragraph 4 (*d*) whether an applicant contracting party has unreasonably failed to offer adequate compensation, it is understood that the CONTRACTING PARTIES will take due account of the special position of a contracting party which has bound a high proportion of its tariffs at very low rates of duty and to this extent has less scope than other contracting parties to make compensatory adjustment.

APPENDIX 2:
SELECTED ARTICLES OF THE SUBSIDIES CODE

Article 8 Subsidies—General Provisions

1. Signatories recognize that subsidies are used by governments to promote important objectives of social and economic policy. Signatories also recognize that subsidies may cause adverse effects to the interests of other signatories.
2. Signatories agree not to use export subsidies in a manner inconsistent with the provisions of this Agreement.
3. Signatories further agree that they shall seek to avoid causing, through the use of any subsidy:
   (a) injury to the domestic industry of another signatory,[23]
   (b) nullification or impairment of the benefits accruing directly or indirectly to another signatory under the General Agreement,[24] or
   (c) serious prejudice to the interests of another signatory.[25]
4. The adverse effects to the interests of another signatory required to demonstrate nullification or impairment[26] or serious prejudice may arise through
   (a) the effects of the subsidized imports in the domestic market of the importing signatory,
   (b) the effects of the subsidy in displacing or impeding the imports of like products into the market of the subsidizing country, or
   (c) the effects of the subsidized exports in displacing[27] the exports of like products of another signatory from a third country market.[28]

Article 9 Export Subsidies on Products Other than Certain Primary Products[29]

1. Signatories shall not grant export subsidies on products other than certain primary products.
2. The practices listed in points (a) to (l) in the Annex are illustrative of export subsidies.

Article 10 Export Subsidies on Certain Primary Products

1. In accordance with the provisions of Article XVI:3 of the General Agreement, signatories agree not to grant directly or indirectly any export subsidy on certain primary products in a manner which results in the signatory granting such subsidy having more than an equitable share of world export trade in such product, account being taken of the shares of the signatories in trade in the product concerned during a previous representative period, and any special factors which may have affected or may be affecting trade in such product.

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2. For purposes of Article XVI:3 of the General Agreement and paragraph 1 above:
   (a) "more than equitable share of world export trade" shall include any case in which the effect of an export subsidy granted by a signatory is to displace the exports of another signatory bearing in mind the developments on world markets;
   (b) with regard to new markets traditional patterns of supply of the product concerned to the world market, region or country, in which the new market is situated shall be taken into account in determining "equitable share of world export trade".
   (c) "a previous representative period" shall normally be the three most recent calendar years in which normal market conditions existed.
3. Signatories further agree not to grant export subsidies on exports of certain primary products to a particular market in a manner which results in prices materially below those of other suppliers to the same market.

Article 11 Subsidies Other than Export Subsidies

1. Signatories recognize that subsidies other than export subsidies are widely used as important instruments for the promotion of social and economic policy objectives and do not intend to restrict the right of signatories to use such subsidies to achieve these and other important policy objectives which they consider desirable. Signatories note that among such objectives are:
   (a) the elimination of industrial, economic and social disadvantages of specific regions,
   (b) to facilitate the restructuring, under socially acceptable conditions, of certain sectors, especially where this has become necessary by reason of changes in trade and economic policies, including international agreements resulting in lower barriers to trade,
   (c) generally to sustain employment and to encourage re-training and change in employment,
   (d) to encourage research and development programmes, especially in the field of high-technology industries,
   (e) the implementation of economic programmes and policies to promote the economic and social development of developing countries,
   (f) redeployment of industry in order to avoid congestion and environmental problems.
2. Signatories recognize, however, that subsidies other than export subsidies, certain objectives and possible form of which are described, respectively, in paragraphs 1 and 3 of this Article, may cause or threaten to cause injury to a domestic industry of another signatory or serious prejudice to the interests of another signatory or may nullify or impair benefits accruing to another signatory under the General Agreement, in particular where such subsidies would adversely affect the conditions of normal competition. Signatories shall therefore seek to avoid causing such effects through the use of subsidies. In particular, signatories, when drawing up their policies and practices in this field, in addition to evaluating the essential internal objectives to be achieved, shall also weigh, as far as practicable, taking account of the nature of the particular case, possible adverse effects on trade. They shall also consider the conditions of world trade, production (e.g. price, capacity utilization etc.) and supply in the product concerned.

3. Signatories recognize that the objectives mentioned in paragraph 1 above may be achieved, *inter alia*, by means of subsidies granted with the aim of giving an advantage to certain enterprises. Examples of possible forms of such subsidies are: government financing of commercial enterprises, including grants, loans or guarantees; government provision or government financed provision of utility, supply distribution and other operational or support services or facilities; government financing of research and development programmes; fiscal incentives; and government subscription to, or provision of, equity capital.

   Signatories note that the above form of subsidies are normally granted either regionally or by sector. The enumeration of forms of subsidies set out above is illustrative and non-exhaustive, and reflects these currently granted by a number of signatories to this Agreement.

   Signatories recognize, nevertheless, that the enumeration of forms of subsidies set out above should be reviewed periodically and that this should be done, through consultations, in conformity with the spirit of Article XVI:5 of the General Agreement.
4. Signatories recognize further that, without prejudice to their rights under this Agreement, nothing in paragraphs 1–3 above and in particular the enumeration of forms of subsidies creates, in itself, any basis for action under the General Agreement, as interpreted by this Agreement.

Article 12 Consultations

1. Whenever a signatory has reason to believe that an export subsidy is being granted or maintained by another signatory in a manner inconsistent with the provisions of this Agreement, such signatory may request consultations with such other signatory.
2. A request for consultations under paragraph 1 above shall include a statement of available evidence with regard to the existence and nature of the subsidy in question.
3. Whenever a signatory has reason to believe that any subsidy is being granted or maintained by another signatory and that such subsidy either causes injury to its domestic industry, nullification or impairment of benefits accruing to it under the General Agreement, or serious prejudice to its interests, such signatory may request consultations with such other signatory.
4. A request for consultations under paragraph 3 above shall include a statement of available evidence with regard to (a) the existence and nature of the subsidy in question and (b) the injury caused to the domestic industry or, in the case of nullification or impairment, or serious prejudice, the adverse effects caused to the interests of the signatory requesting consultations.
5. Upon request for consultations under paragraph 1 or paragraph 3 above, the signatory believed to be granting or maintaining the subsidy practice in question shall enter into such consultations as quickly as possible. The purpose of the consultations shall be to clarify the facts of the situation and to arrive at a mutually acceptable solution.

Article 13 Conciliation, Dispute Settlement and Authorized Countermeasures

1. If, in the case of consultations under paragraph 1 of Article 12, a mutually acceptable solution has not been reached within thirty days[10] of the request for consultations,

any signatory party to such consultations may refer the matter to the Committee for conciliation in accordance with the provisions of Part VI.

2. If, in the case of consultations under paragraph 3 of Article 12, a mutually acceptable solution has not been reached within sixty days of the request for consultations, any signatory party to such consultations may refer the matter to the Committee for conciliation in accordance with the provisions of Part VI.
3. If any dispute arising under this Agreement is not resolved as a result of consultations or conciliations, the Committee shall, upon request, review the matter in accordance with the dispute settlement procedures of Part VI.
4. If, as a result of its review, the Committee concludes that an export subsidy is being granted in a manner inconsistent with the provisions of this Agreement or that a subsidy is being granted or maintained in such a manner as to cause injury, nullification or impairment, or serious prejudice, it shall make such recommendations[31] to the parties as may be appropriate to resolve the issue and, in the event the recommendations are not followed, it may authorize such countermeasures as may be appropriate, taking into account the degree and nature of the adverse effects found to exist, in accordance with the relevant provisions of Part VI.

Notes

23. Injury to the domestic industry is used here in the same sense as it is used in Part I of this Agreement.

24. Benefits accruing directly or indirectly under the General Agreement include the benefits of tariff concessions bound under Article II of the General Agreement.

25. Serious prejudice to the interests of another signatory is used in this Agreement in the same sense as it is used in Article XVI:1 of the General Agreement and includes threat of serious prejudice.

26. Signatories recognize that nullification or impairment of benefits may also arise through the failure of a signatory to carry out its obligations under the General Agreement or this Agreement. Where such failure concerning export subsidies is determined by the Committee to exist, adverse effects may, without prejudice to paragraph 9 of Article 18 below, be presumed to exist. The other signatory will be accorded a reasonable opportunity to rebut this presumption.

27. The term "displacing" shall be interpreted in a manner which takes into account the trade and development needs of developing countries and in this connection is not intended to fix traditional market shares.

28. The problem of third country markets so far as certain primary products are concerned is dealt with exclusively under Article 10 below.

29. For purposes of this Agreement "certain primary products" means the products referred to in Note Ad Article XVI of the General Agreement, Section B, paragraph 2, with the deletion of the words "or any mineral."

30. Any time periods mentioned in this Article and in Article 18 may be extended by mutual agreement.

31. In making such recommendations, the Committee shall take into account the trade, development and financial needs of developing country signatories.

Annex Illustrative List of Export Subsidies

(a) The provision by governments of direct subsidies to a firm or an industry contingent upon export performance.

(b) Currency retention schemes or any similar practices which involve a bonus on exports.

(c) Internal transport and freight charges on export shipments, provided or mandated by governments, on terms more favourable than for domestic shipments.

(d) The delivery by governments or their agencies of imported or domestic products or services for use in the production of exported goods, on terms or conditions more favourable than for delivery of like or directly competitive products or services for use in the production of goods for domestic consumption, if (in the case of products) such terms or conditions are more favourable than those commercially available on world markets to their exporters.

(e) The full or partial exemption, remission, or deferral specifically related to exports, of direct taxes[1] or social welfare charges paid or payable by industrial or commercial enterprises.[2]

(f) The allowance of special deductions directly related to exports or export performance, over and above those granted in respect to production for domestic consumption, in the calculation of the base on which direct taxes are charged.

(g) The exemption or remission in respect of the production and distribution of exported products, of indirect taxes[1] in excess of those levied in respect of the production and distribution of like products when sold for domestic consumption.

(h) The exemption, remission or deferral of prior stage cumulative indirect taxes[1] on goods or services used in the production of exported products in excess of the exemption, remission or deferral of like prior stage cumulative indirect taxes on goods or services used in the production of like products when sold for domestic consumption; provided, however, that prior stage cumulative indirect taxes may be exempted, remitted or deferred on exported products even when not exempted, remitted or deferred on like products when sold for domestic consumption, if the prior stage cumulative indirect taxes are levied on goods that are physically incorporated (making normal allowance for waste) in the exported product.[3]

(i) The remission or drawback of import charges[1] in excess of those levied on imported goods that are physically incorporated (making normal allowance for waste) in the exported product; provided, however, that in particular cases a firm may use a quantity of home market goods equal to, and having the same quality and characteristics as, the imported goods as a substitute for them in order to benefit from this provision if the import and the corresponding export operations both occur within a reasonable time period, normally not to exceed two years.

(j) The provision by governments (or special institutions controlled by governments) of export credit guarantees or insurance programmes, of insurance or guarantee programmes against increases in the costs of exported products[4] or of exchange risk programmes, at premium rates, which are manifestly inadequate to cover the long-term operating costs and losses of the programmes.[5]

(k) The grant by governments (or special institutions controlled by and/or acting under the authority of governments) of export credits at rates below those which they actually have to pay for the funds so employed (or would have to pay if they borrowed on international capital markets in order to obtain funds of the same maturity and denominated in the same currency as the export credit), or the payment by them of all or part of the costs incurred by exporters or financial institutions in obtaining credits, in so far as they are used to secure a material advantage in the field of export credit terms.

Provided, however, that if a signatory is a party to an international undertaking on official export credits to which at least twelve original signatories[6] to this Agreement are parties as of 1 January 1979 (or a successor undertaking which has been adopted by those original signatories), or if in practice a signatory applies the interest rates provisions of the relevant undertaking, an export credit practice which is in conformity with those provisions shall not be considered an export subsidy prohibited by this Agreement.

(l) Any other charge on the public account constituting an export subsidy in the sense of Article XVI of the General Agreement.

Notes

1. For the purpose of this Agreement:

The term "direct taxes" shall mean taxes on wages, profits, interest, rents, royalties, and all other forms of income, and taxes on the ownership of real property;

The term "import charges" shall mean tariffs, duties, and other fiscal charges not elsewhere enumerated in this note that are levied on imports;

The term "indirect taxes" shall mean sales, excise, turnover, value added, franchise, stamp, transfer, inventory and equipment taxes, border taxes and all taxes other than direct taxes and import charges;

"Prior stage" indirect taxes are those levied on goods or services used directly or indirectly in making the product;

"Cumulative" indirect taxes are multi-staged taxes levied where there is no mechanism for subsequent crediting of the tax if the goods or services subject to tax at one stage of the production are used in a succeeding stage of production;

"Remission" of taxes includes the refund or rebate of taxes.

2. The signatories recognize that deferral need not amount to an export subsidy where, for example, appropriate interest charges are collected. The signatories further recognize that nothing in this text prejudges the disposition by the CONTRACTING PARTIES of the specific issues raised in GATT document L/4422. The signatories reaffirm the principle that prices for goods in transactions between exporting enterprises and foreign buyers under their or under the same control should for tax purposes be the prices which would be charged between independent enterprises acting at arm's length. Any signatory may draw the attention of another signatory to administrative or other practices which may contravene this principle and which result in a significant saving of direct taxes in export transactions. In such circumstances the signatories shall normally attempt to resolve their differences using the facilities of existing bilateral tax treaties or other specific international mechanisms, without prejudice to the rights and obligations of signatories under the General Agreement, including the right of consultation created in the preceding sentence.

Paragraph (e) is not intended to limit a signatory from taking measures to avoid the double taxation of foreign source income earned by its enterprises of the enterprises of another signatory.

Where measures incompatible with the provisions of paragraph (e) exist, and where major practical difficulties stand in the way of the signatory concerned bringing such measures promptly into conformity with the Agreement, the signatory concerned shall, without prejudice to the rights of other signatories under the General Agreement or this Agreement, examine methods of bringing these measures into conformity within a reasonable period of time.

In this connexion the European Economic Community has declared that Ireland intends to withdraw by 1 January 1981 its system of preferential tax measures related to exports, provided for under the Corporation Tax Act of 1976, whilst continuing nevertheless to honour legally binding commitments entered into during the lifetime of this system.

3. Paragraph (h) does not apply to value-added tax systems and border-tax adjustment in lieu thereof; the problem of the excessive remission of value-added taxes is exclusively covered by paragraph (g).

4. The signatories agree that nothing in this paragraph shall prejudge or influence the deliberations of the panel established by the GATT Council on 6 June 1978 (C/M/126).

5. In evaluating the long-term adequacy of premium rates, costs and losses of insurance programmes, in principle only such contracts shall be taken into account that were concluded after the date of entry into force of this Agreement.

6. An original signatory to this Agreement shall mean any signatory which adheres *ad referendum* to the Agreement on or before 30 June 1979.

APPENDIX 3: MINISTERIAL DECLARATION ON THE URUGUAY ROUND

PART I

NEGOTIATIONS ON TRADE IN GOODS

. . .

A. OBJECTIVES

Negotiations shall aim to:

(i) bring about further liberalization and expansion of world trade to the benefit of all countries, especially less-developed contracting parties, including the improvement of access to markets by the reduction and elimination of tariffs, quantitative restrictions and other non-tariff measures and obstacles;

(ii) strengthen the role of GATT, improve the multilateral trading system based on the principles and rules of the GATT and bring about a wider coverage of world trade under agreed, effective and enforceable multilateral disciplines;

. . .

B. GENERAL PRINCIPLES GOVERNING NEGOTIATIONS

(i) Negotiations shall be conducted in a transparent manner, and consistent with the objectives and commitments agreed in this Declaration and with the principles of the General Agreement in order to ensure mutual advantage and increased benefits to all participants.

(ii) The launching, the conduct and the implementation of the outcome of the Negotiations shall be treated as parts of a single undertaking. However, agreements reached at an early stage may be implemented on a provisional or a definitive basis by agreement prior to the formal conclusion of the Negotiations. Early agreements shall be taken into account in assessing the overall balance of the negotiations.

(iii) Balanced concessions should be sought within broad trading areas and subjects to be negotiated in order to avoid unwarranted cross-sectoral demands.

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(iv) CONTRACTING PARTIES agree that the principle of differential and more favorable treatment embodied in Part IV and other relevant provisions of the General Agreement and in the Decision of the CONTRACTING PARTIES of 28 November 1979 on Differential and More Favourable Treatment, Reciprocity and Fuller Participation of Developing Countries applies to the negotiations. In the implementation of standstill and rollback, particular care should be given to avoiding disruptive effects on the trade of less-developed contracting parties.

(v) The developed countries do not expect reciprocity for commitments made by them in trade negotiations to reduce or remove tariffs and other barriers to the trade of developing countries, i.e., the developed countries do not expect the developing countries, in the course of trade negotiations, to make contributions which are inconsistent with their individual development, financial and trade needs. Developed contracting parties shall therefore not seek, neither shall less-developed contracting parties be required to make, concessions that are inconsistent with the latter's development, financial and trade needs.

(vi) Less-developed contracting parties expect that their capacity to make contributions or negotiated concessions or take other mutually agreed action under the provisions and procedures of the General Agreement would improve with the progressive development of their economies and improvement in their trade situation and they would accordingly expect to participate more fully in the framework of rights and obligations under the General Agreement.

(vii) Special attention shall be given to the particular situation and problems of the least-developed countries and to the need to encourage positive measures to facilitate expansion of their trading opportunities. Expeditious implementation of the relevant provisions of the 1982 Ministerial Declaration concerning the least-developed countries shall also be given appropriate attention.

C. STANDSTILL AND ROLLBACK

Commencing immediately and continuing until the formal completion of the Negotiations, each participant agrees to apply the following commitments:

Standstill

(i) not to take any trade restrictive or distorting measure inconsistent with the provisions of the General Agreement or the Instruments negotiated within the framework of GATT or under its auspices;

(ii) not to take any trade restrictive or distorting measure in the legitimate exercise of its GATT rights, that would go beyond that which is necessary to remedy specific situations, as provided for in the General Agreement and the Instruments referred to in (i) above;

(iii) not to take any trade measures in such a manner as to improve its negotiating positions.

Rollback

(i) that all trade restrictive or distorting measures inconsistent with the provisions of the General Agreement or instruments negotiated within the framework of GATT or under its auspices, shall be phased out or brought into conformity within an agreed time frame not later than by the date of the formal completion of the negotiations, taking into account multilateral agreements, undertakings and understandings, including strengthened rules and disciplines, reached in pursuance of the Objectives of the Negotiations;

. . .

D. SUBJECTS FOR NEGOTIATIONS

Tariffs

Negotiations shall aim, by appropriate methods, to reduce or, as appropriate, eliminate tariffs including the reduction or elimination of high tariffs and tariff escalation. Emphasis shall be given to the expansion of the scope of tariff concessions among all participants.

Non-tariff Measures

Negotiations shall aim to reduce or eliminate non-tariff measures, including quantitative restrictions, without prejudice to any action to be taken in fulfillment of the rollback commitments.

Tropical Products

Negotiations shall aim at the fullest liberalization of trade in tropical products, including in their processed and semi-processed forms and shall cover both tariff and all non-tariff measures affecting trade in these products.

. . .

Natural Resource-Based Products

. . .

Textiles and Clothing

. . .

Agriculture

CONTRACTING PARTIES agree that there is an urgent need to bring more discipline and predictability to world agricultural trade by correcting and preventing restrictions and distortions including those related to structural surpluses so as to reduce the uncertainty, imbalances and instability in world agricultural markets.

Negotiations shall aim to achieve greater liberalization of trade in agriculture and bring all measures affecting import access and export competition under strengthened and more operationally effective GATT rules and disciplines, taking into account the general principles governing the negotiations, by:

(i) improving market access through, *inter alia,* the reduction of import barriers;

(ii) improving the competitive environment by increasing discipline on the use of all direct and indirect subsidies and other measures affecting directly or indirectly the phased reduction of their negative effects and dealing with their causes;

(iii) minimizing the adverse effects that sanitary and phytosanitary regulations and barriers can have on trade in agriculture, taking into account the relevant international agreements.

In order to achieve the above objectives, the negotiating group having responsibility for all aspects of agriculture will use the recommendations adopted by the CONTRACTING PARTIES at their Fortieth Session, which were developed in accordance with the GATT 1982 Ministerial Programme and take account of the approaches suggested in the work of the Committee on Trade in Agriculture without prejudice to other alternatives that might achieve the objectives of the Negotiations.

GATT Articles

Participants shall review existing GATT articles, provisions and disciplines as requested by interested contracting parties, and, as appropriate, undertake negotiations.

Safeguards

(i) A comprehensive agreement on safeguards is of particular importance to the strengthening of the GATT system and to progress in the MTNs.

(ii) The agreement on safeguards:
— shall be based on the basic principles of the General Agreement;
— shall contain, *inter alia*, the following elements: transparency, coverage, objective criteria for action including the concept of serious injury or threat thereof, temporary nature, degressivity and structural adjustment, compensation and retaliation, notifications, consultation, multilateral surveillance and dispute settlement; and
— shall clarify and reinforce the disciplines of the General Agreement and should apply to all contracting parties.

MTN Agreements and Arrangements

Negotiations shall aim to improve, clarify, or expand, as appropriate, agreements and arrangements negotiated in the Tokyo Round of Multilateral Negotiations.

Subsidies and Countervailing Measures

Negotiations on subsidies and countervailing measures shall be based on a review of Articles VI and XVI and the MTN agreement on subsidies and countervailing measures with the objective of improving GATT disciplines relating to all subsidies and countervailing measures that affect international trade. A negotiating group will be established to deal with these issues.

Dispute Settlement

In order to ensure prompt and effective resolution of disputes to the benefit of all contracting parties, negotiations shall aim to improve and strengthen the rules and the procedures of the dispute settlement process, while recognizing the contribution that would be made by more effective and enforceable GATT rules and disciplines. Negotiations shall include the development of adequate arrangements for overseeing and monitoring of the procedures that would facilitate compliance with adopted recommendations.

Trade Related Aspects of Intellectual Property Rights, including Trade in Counterfeit Goods

. . .

Trade-Related Investment Measures

. . .

E. FUNCTIONING OF THE GATT SYSTEM

Negotiations shall aim to develop understandings and arrangements:

(i) to enhance the surveillance in the GATT to enable regular monitoring of trade policies and practices of contracting parties and their impact on the functioning of the multilateral trading system;

(ii) to improve the overall effectiveness and decision-making of the GATT as an institution, including, *inter alia*, through involvements of ministers;

(iii) to increase the contribution of the GATT to achieving greater coherence in global economic policy-making through strengthening its relationship with other international organizations responsible for monetary and financial matters.

F. PARTICIPATION

. . .

G. ORGANIZATION OF THE NEGOTIATIONS

A Group of Negotiations on Goods (GNG) is established to carry out the programme of negotiations contained in this part of the Declaration. The GNG shall, *inter alia:*

. . .

(iii) establish negotiating groups as required. . . .

. . .

(v) coordinate the work of the negotiating groups and supervise the progress of the negotiations. As a guideline, not more than two negotiating groups should meet at the same time;

. . .

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R5620-1.16 F(4) 2/89

RESEARCH REPORT

71

STORAGE, TRADE, AND PRICE POLICY UNDER PRODUCTION INSTABILITY: MAIZE IN KENYA

Thomas C. Pinckney

December 1988

INTERNATIONAL
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STORAGE, TRADE, AND PRICE POLICY UNDER PRODUCTION INSTABILITY: MAIZE IN KENYA

Thomas C. Pinckney

Research Report 71
International Food Policy Research Institute
December 1988

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Library of Congress Cataloging
in Publication Data

Pinckney, Thomas C.
Storage, trade, and price policy under production instability.

(Research report ; 71)
"December 1988."
Bibliography: p. 97.
1. Corn industry—Government policy—Kenya. I. Title. II. Series: Research report (International Food Policy Research Institute) ; 71.

HD9049.C8K47 1989 338.1'8 88-35809
ISBN 0-89629-073-5

CONTENTS

Foreword

1. Summary 9

2. Introduction 11

3. Methodological Approach 18

4. A Production Instability Model for Kenya 28

5. An Examination of Price Band and Optimal Policies 55

6. Trade-offs Between Government Objectives 73

7. Conclusions and Policy Implications 82

Appendix 1: Supplementary Tables 88

Appendix 2: Pseudocodes for Price Band and Optimization Programs 94

Bibliography 97

TABLES

1. Rural market maize grain prices, September 1984 15
2. Optimal storage versus certainty equivalence storage 23
3. Dynamic programming example: terminal year payoffs 25
4. Dynamic programming example: year T−1 payoff calculations 25
5. Different series of maize production in Kenya 29
6. Derivation of maize "consumption" series 30
7. Expected values of world price in dynamic programming models 41
8. Differences between price band simulation and dynamic programming models 49
9. Costs of exporting maize 50
10. Kitale rainfall: April and May, 1953-84 53
11. Price band results 57
12. Optimal policy results 61
13. Simulation of price band and optimal policies: one cycle 65
14. Trade-offs between objectives: price band and optimal 73
15. Adjusting the price band policy 77
16. Price band results for demand elasticity equal −0.2 88
17. Price band results for production variability equal 12 percent 89
18. Optimal policy results for demand elasticity equal −0.2 90
19. Optimal policy results for production instability equal 12 percent 91
20. Price band results for comparison with optimal 92
21. Trade-offs with price elasticity equal −0.2 93
22. Trade-offs with production variability equal 12 percent 93

ILLUSTRATIONS

1. Net purchases function implied by price band policy 20
2. Maize production and trends, 1970/71-1983/84 32
3. Maize production frequency diagram, 1970/71-1984/85 35
4. Price band trade-off curves 56
5. Optimal policy trade-off curves 60
6. Price band trade-off curves for comparison with optimal 62
7. Price band versus optimal policies for price variability of 12.1 63
8. Price frequencies: price band policy 66
9. Price frequencies: optimal policy 67
10. Net purchases: price band versus optimal for opening stock = 0 68
11. Net purchases: price band versus optimal for opening stock = 400 69
12. Optimal net purchases for different objective function weights 70
13. Optimal closing stocks and exports 71
14. Stocks: optimal versus price band policy at different world prices 72
15. Moving toward the optimal: price band policy modifications 78

FOREWORD

Instability in the production of a staple food causes severe hardship for many countries. For a country that is self-sufficient in its staple food in a normal production year, the large swings in price and consumption that result from an exclusive and uninhibited reliance on trade to stabilize prices are unacceptable. Most countries, therefore, intervene in their domestic cereal markets and move supplies from surplus to deficit years through storage or by subsidizing international trade. The appropriate method of intervention and the most efficient way to achieve supply stability thus become topics of study. For the most part, economists have encouraged governments to rely more on trade than on stocks to make up deficits in years of production shortfalls.

Trade becomes less appealing as an option the larger the difference between import and export parity prices, and the greater the deviation in physical characteristics between the domestically consumed commodity and the imported commodity. Storage is more likely to be appropriate for African countries, since many of them have high transport costs and consume a commodity—white maize—that is often in short supply on world markets.

The International Food Policy Research Institute has examined these issues previously in books and research reports. *Food Security for Developing Countries,* edited by Alberto Valdés, discusses these issues in some detail. *International Finance for Food Security,* edited by Barbara Huddleston et al., is a study of ways that the international community can remove some of the risks of relying on trade rather than stocks. In IFPRI Research Report 26, *Food Security in the Sahel: Variable Import Levy, Grain Reserves, and Foreign Exchange Assistance,* John McIntire examines various policy options for dealing with instability in the Sahelian region.

In this report, Thomas Pinckney develops a general framework for studying these issues and applies it to the case of Kenya. The framework builds both on the optimal storage literature and on simulation studies. Trade-offs between the government objectives of minimizing price fluctuations, imports, and fiscal costs are measured explicitly. The techniques that make the optimal policies superior to simpler price band/buffer stock policies are studied in order to provide clues for efficient policy design. In terms of the storage/trade debate, this report finds that Kenya does indeed have a strong rationale for a significant amount of storage when world maize prices are at their present low levels.

Techniques developed in this research report have been modified and applied to Pakistan and will be applied to several southern African countries in the future. This will provide the coherent set of studies required to make generalizations about these important questions.

John W. Mellor

Washington, D.C.
December 1988

ACKNOWLEDGMENTS

This study was undertaken in several different stages through the support of a number of different persons and organizations. Consequently, my debts are even greater than those usually incurred by authors.

The study began in 1983 as one part of an interministerial report on grain marketing. John Cohen of the Harvard Institute for International Development had been responsible for hiring a raw graduate student 18 months earlier, and Dick Goldman named me to the study team for the report. Dick has been a good friend and stimulating colleague ever since; many thanks are due him.

Following my departure from Kenya, the report took on a semblance of its present shape when it was transformed into my doctoral dissertation at Stanford's Food Research Institute. HIID provided funding for part of my support during the writing period. My dissertation committee was helpful throughout, particularly Carl Gotsch, the chairman. Carl also was primarily responsible for producing an article based on the dissertation, "Simulation and Optimization of Price Stabilization Policies: Maize in Kenya," which appeared in *Food Research Institute Studies* 20:3.

After I came to the International Food Policy Research Institute to work on a similar study of Pakistan, Alberto Valdés encouraged me to revise my thesis for submission as an IFPRI Research Report. Chris Delgado, Marc Nerlove, Uma Lele, and an anonymous reviewer provided helpful comments.

1

SUMMARY

Kenya has been faced with the problem of production instability for as long as records have been kept. Over the last 10-year period, the country has produced about the same amount of its staple food, white maize, as it has consumed. During normal weather years, private markets have cleared at prices that are between import parity and export parity. Yet the country faced severe shortages in 1980 and 1984, and in early 1987 was faced with the opposite problem of a large excess supply. The strategy the government pursues in managing these fluctuations in supply has important ramifications for the government budget and the government's political support.

For most of the period since independence, Kenya's stated policy in this regard has been simple: all maize that is not sold directly from a producer to a consumer is to be sold to a parastatal marketing board, the National Cereals and Produce Board (NCPB). The NCPB is instructed to buy all the maize that it is offered at a price set by the government, and to sell all the maize that is demanded at a higher price, also set by the government. Since the government purchase price is set before planting, there is no sensitivity to the size of the crop. By law, therefore, there is to be no fluctuation in producer prices.

In reality, both consumers and producers have faced large fluctuations in prices. The government has not given the NCPB the fiscal resources necessary to fulfill its mandate. The NCPB has responded in surplus years by delaying payments to farmers, forcing prospective sellers to wait in long lines, and rejecting many lots in the name of quality control. In deficit years, millers have not been able to buy as much as they desire at the set price. The result has been the dependence of a large percentage of farmers and consumers on the parallel informal market and large fluctuations in price on that market.

This policy has been increasingly difficult for the government to pursue, as fiscal austerity has been recognized as vital to Kenya's long-term development. Thus a systematic analysis of policies for countering production instability is in order; in particular, it is important that the analysis be conducted from the government's perspective by measuring trade-offs between different government objectives.

The three objectives considered here are minimizing price fluctuations, minimizing fiscal cost, and minimizing imports. Minimizing imports is a separate goal over and above the cost involved for two reasons: first, imported maize is yellow, while locally grown maize is white; second, most Kenyans believe that their country should be self-sufficient in its staple food.

A common policy prescription from earlier studies is for the NCPB to defend floor and ceiling prices for maize rather than to engage in primary marketing. This policy option, with foreign trade triggered by the stock level, is termed a "price band policy" here. Price band policies with different band widths and stock triggers are simulated in this study in order to examine their effects on the three government objectives. This allows for the measurement of trade-offs between objectives.

These estimates of trade-offs will be accurate if the price band policies are efficient. There are theoretical reasons, however, for believing that such policies are inefficient. To obtain accurate estimates of the trade-offs, Kenya's storage and trade problems are solved using a model that produces the best values for domestic purchases and sales, foreign trade, and domestic stocks, given any particular system of government preferences for the three objectives. The optimization method used, stochastic dynamic programming, guarantees that the estimates of trade-offs between objectives are accurate, since the most efficient policy has been chosen.

A simple model is developed with random production fluctuations and random movements in the world price of maize. The government responds by purchasing and selling maize both domestically and internationally and storing the result of those transactions. Because the most efficient policy will depend on how much the government values, say, price stability vis-à-vis fiscal cost, the optimization exercise is carried out with several different weightings of the three government objectives. Price band policies with different-width price bands and different stock triggers for international trade are tested also.

For the same level of imports and price stability, the policies that come out of the optimization procedure cost about US$1.5 million less annually than the price band policies. These cost savings result primarily from increased flexibility. In the optimal policies, the domestic price is sensitive to the world price, domestic production, and the government's opening stock, while the maximum stock level (which triggers exports) is sensitive to the world price.

Trade-offs between fiscal cost and price stability as measured by the price band policies are found to be lower than the true trade-offs. As measured by the optimal policies, the average annual cost of decreasing the standard deviation of price by $1.00 per metric ton is $400,000-$600,000 annually, with the larger values occurring as the standard deviation moves towards zero. On the other hand, the price band policies overestimate the cost of decreasing imports. The correct trade-off is $60,000-$130,000 annually per 1,000-ton decrease in average annual imports, with the higher values occurring as average annual imports decline.

Despite the advantages of the policies that are produced by the optimization procedure, it would be incorrect to recommend that the government adopt such rules for several reasons. Most important, the optimal policies are much more complex than the price band policies. The government has an objective of designing relatively simple policies, but this objective is not easily built into an optimizing model. There is thus a trade-off between the cost of a policy and its complexity.

The lessons learned about optimal policy design are introduced into the price band policy one by one in order to design a policy that is efficient, yet retains the desirable simplicity of the price band policy. About two-thirds of the difference between the optimal and price band policies can be made up by allowing the domestic price to be sensitive to the world price and opening stocks and by making the maximum stock level sensitive to the world price. Further efficiency gains can only be made by allowing the crop size to influence the official domestic price.

Three major policy conclusions are made. First, there is no one optimal stock level, but the most appropriate closing stock level in any one year is a function of the opening stock level, production, and the world price. Second, by adding some flexibility to official prices, significant cost savings could be incurred, which would make it more likely that the NCPB would be given sufficient fiscal resources to defend the official price. Thus, price instability faced by Kenyan producers and consumers could actually decrease even though official prices would not be totally stable. Third, the degree of price flexibility required to achieve significant cost savings is not large, as shown by the trade-off between fiscal cost and price stability.

2

INTRODUCTION

In the 1981/82 crop year, Kenya produced approximately 2.5 million metric tons[1] of its staple crop, white maize. This bumper crop, which was 20 percent higher than the previous record, caused serious financial problems for the country's grain-marketing parastatal, the National Cereals and Produce Board (NCPB). The board was unable to pay farmers for their crop on delivery. In some cases depot managers simply refused to buy more maize; in others, farmers were forced to wait as long as nine months for payment. NCPB stores were full of maize and beans, with substantial quantities stored outside under tarpaulins. For a country that had experienced a fairly severe food crisis only two years before and had been labeled a chronic maize importer by many "experts," the experience was both relieving and terribly costly. With memories of queues for maize in Nairobi still fresh in everyone's mind, the government was reluctant to approve exports when imports might be required in the near future. Yet the country was in the middle of a financial crisis, with foreign reserves at their lowest point ever.

Rather belatedly, the cabinet decided to allow the NCPB to export maize during 1983 and 1984 after two reasonably good crop years. Over 100,000 tons were exported in January and February 1984. During April and May of that year, however, the government's worst fears were realized: not only were the rains in semiarid Eastern Province low for the third year in a row, but the normally reliable rains in parts of the Rift Valley were only 50 percent of normal. Failure of the rains in this breadbasket of the country led to a severe national shortage in addition to the anticipated purchasing-power problem in the east.

From the very beginning of the crisis, debate raged in the press about the maize that had been exported in January and February 1984. Unnamed officials were accused of corruption while the populace waited in queues for any white maize that became available. For about two weeks in August 1984 there was no maize meal to buy in Nairobi shops, despite assurances from the government about the adequacy of maize supplies in the country. The supply situation for maize in the rural areas was even more erratic. The failure of the bean and potato crops took away two of the most important alternative sources of calories in Central and Eastern provinces.

The government was reluctant to take the logical step of importing maize. Imports present Kenya with a threefold problem. First, the NCPB selling price of maize is determined in advance and in 1984/85 was between the import and export parity prices. As Kenya was exporting maize at planting time, this price was reasonable. But if the country was to maintain its tradition of holding official prices constant, the government would suffer large losses on every ton of imported maize sold domestically, even without correcting for Kenya's marginally overvalued exchange rate. Second, there is a strong feeling in the country that Kenya can and should be self-sufficient in maize. Imports are normally interpreted as a policy failure, and this would be especially true in 1984, since the country had exported in the first two months of the year. Indeed, a December 1984 review of the year's events in the local press was entitled

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[1] All tons referred to in this report are metric tons.

"Disturbing Year: Drought, Inefficiency, and Lack of Foresight Lead to Hunger."[2] Third, Kenyans produce and consume white maize, and virtually all of the maize on the international market is yellow. When there is sufficient rain in southern Africa, South Africa exports a significant amount of white maize, but there are obvious problems for a black African country in buying that maize. Thus Kenya imports yellow maize, which looks and tastes different from the local product. The country's citizens are reminded every time they sit down to eat that their government has failed to meet one of its most important goals. Obviously, government decisionmakers want to avoid all three of these problems.

Throughout the first half of 1984 the official price remained constant. Local markets, on the other hand, began to react earlier to the low rainfall. With local market prices higher than the NCPB selling price, demand for NCPB maize increased dramatically. In May the NCPB had net sales of almost 90,000 tons, breaking the previous one-month record (of July 1980) by almost 40 percent. From May to July, NCPB net sales were about 306,000 tons, breaking the previous three-month record by an extraordinary 80 percent. The government's stockpile was being depleted rapidly.

By early July the government had realized that its stock position was untenable and reluctantly arranged for imports. Several development projects were delayed or curtailed because of the expected cost of the import program, which would eventually bring in almost 1 million tons during 1984/85. The administrative costs were also high, as key decisionmakers in the government spent large blocks of time trying to manage the problem.

The problems presented above are not new. Indeed, one of the most interesting descriptions of the issues still facing the Kenyan government was written by a Maize Commission of Inquiry more than 20 years ago (Kenya 1966):

> The dominant feature in the price structure for maize is the wide differential between the import parity and export parity prices. . . . The sharp fluctuations in the annual supply, and the inflexible total consumer demand mean . . . that it is virtually impossible to plan production exactly to meet domestic demand, even allowing for the holding of an unduly large and costly domestic reserve stock, without incurring the need to export or import at a loss from time to time. . . . It is against this cost and price background that the Government has to determine the appropriate organization for handling maize, and to fix prices to the producer, the miller, the distributor, and the consumer.

The report recognizes the fundamental problem of production variability and the costs associated with depending on storage or trade alone to deal with the problem, while accepting without comment the government's desire to mandate prices at each stage of the marketing chain. Twenty years later the government is trying to manage the same problem in an ad hoc way as each crisis comes along. Considering the Maize Commission of Inquiry report and other studies conducted during the last 60 years, Maratim (1982) laments:

> Since the first documented maize crisis of 1918, periodic maize shortages have provoked thirteen commissions of inquiry, working parties or select committees to investigate and make recommendations on the pricing and marketing of maize in the country. Most of these investigations have conducted expert analysis and made responsible recommendations only to see maize policy continue to be made on an ad hoc basis, with the authorities acting too late to avert the immediate crisis and then taking little remedial action until the next crisis.

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[2] *Weekly Review* (Nairobi), December 21, 1984.

There is hope that this situation is changing. Until the 1980s, maize marketing was not a major component of government cost. The studies and commissions of inquiry were conducted after each crisis, but as the situation returned to normal the politicians felt less inclined to make the sort of difficult decisions necessary for a major change in maize marketing. During this decade, however, the situation has never returned to "normal." Between 1979 and 1984 the NCPB consumed from 10 to 20 percent of the total amount spent by the Ministry of Agriculture and Livestock Development.[3] This is in contrast to the early 1970s, when the board was virtually breaking even. With NCPB costs continuing to consume a larger and larger proportion of the country's agricultural sector investment, there is a much broader constituency for reforming maize marketing than at any time in the past.

NCPB losses began to increase at the same time that the difference between government expenditures and revenues began to grow to disturbing proportions. High coffee prices in the late 1970s had increased government revenues substantially, and as a consequence fiscal discipline in the government became lax (Pinckney, Cohen, and Leonard 1982; Leonard, Cohen, and Pinckney 1983). The size of the budget deficit prompted the president to appoint a Working Party on Government Expenditures in 1982 to study the problem. The report of the working party (Kenya 1982) states that

> Not to reduce the gap between revenue and expenditure would entail expansionary fiscal and monetary policies and creation of excessive domestic credit. This path would aggravate rather than ameliorate the economic circumstances facing the nation. . . It is not enough, however, merely to curtail Government expenditure, that is, 'to cut our coat according to the size of our cloth.' While Government expenditure must be contained within feasible limits, the development of the nation must continue. . . . As a consequence, Government must in the years ahead . . . allocate its expenditures according to orderly priorities.

The budget deficit has led to an emphasis on sorting out government priorities in different areas of public policy. The growing importance of the subvention to the NCPB as a proportion of total funds spent on the agricultural sector highlights maize marketing as one important area where priorities need to be examined. Add to these internal pressures the interest of major donors in reform, and it would appear likely that within the next few years some changes will be made in maize-marketing policy. Given this possible "window of opportunity," a systematic analysis of methods to deal with the problem is in order; in particular, it is important that an analysis be conducted from the government's perspective, measuring trade-offs between different government priorities.

This study, then, examines trade, stockholding, and pricing strategies that can be used to deal with production instability in Kenya. The primary goal of the analysis is to measure the trade-offs between three government objectives: minimizing price fluctuations, minimizing fiscal costs, and minimizing imports. The last two goals are clear and have been described above; the first requires further elaboration.

Price stability as it is used here measures average annual deviations from a target real price. The government wants farmers to be assured of a reasonable price and wants consumers to be satisfied with the price and quantity available. The history of price control dates back to the Second World War and is deeply ingrained in the political preferences of the government. This is more clearly seen by what the government has

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[3] Richard Goldman, personal communication, October 1985.

not done than by any action or statement. Despite large losses on every ton of maize that was imported and sold domestically in 1980/81 and 1984/85, the government official price remained firm. Similarly, in 1981/82 when buying the bumper crop caused the NCPB to run out of cash, official prices did not decrease. Reports such as the one by the 1966 Maize Commission of Inquiry that was quoted above accept this government goal without comment.[4]

This study will attempt to measure the trade-offs between this price stability goal and the fiscal and self-sufficiency goals in order to measure the cost of stabilizing prices. At the outset, however, it is important to note that the study is dealing with questions of annual, national supply, and not with regional or seasonal shortages. This choice of objective does not imply that fluctuations in food supply by season or within provinces, districts, villages, or households are less important.[5] Nor does the choice of objective imply that food crises can be averted simply by ensuring adequate levels of national supply. As Sen (1981) has pointed out, famines often are associated more closely with the loss of purchasing power by large segments of the population than with supply fluctuations alone. Nevertheless, ensuring adequate national supply is a necessary, albeit not sufficient, condition for averting famine, and questions related to this issue are to a large extent separable from regional and seasonal factors. In addition, as the brief history above illustrates, a country like Kenya needs to examine maize pricing, stockholding, and trading strategies that will provide guidelines for action in exceptionally good years and normal years, not only in years of shortfall. The following brief review of the policy context points out that the government has not in fact been meeting its price stability goal despite high fiscal expenditures.

By law, the government has complete control of the marketing system in the country, with the NCPB acting as its agent.[6] Before planting each year, the government announces the price at which it will buy maize at harvest time.[7] The government also calculates corresponding selling prices at each level of the marketing chain, including the retail price of a 2-kilogram packet of sifted meal, but these selling prices usually are not made final until a later date. They are announced and take immediate effect close to the beginning of the first harvest. The NCPB is supposed to purchase all of the maize that it is offered at its buying price and to supply all that millers and agents want to purchase at its selling price. All foreign trade is handled by the board, but trade decisions are made by the cabinet, not the NCPB.

Most transactions other than those involving the board at the chosen price are illegal. Farmers may legally sell maize to persons whose families will consume it directly, but may not sell to traders or to institutions. All other sales are supposed to be handled by the NCPB. In fact, the government allows trade in rural markets within districts, although in most years large millers are required to buy from the board.

Restrictions on the movement of maize are enforced much more rigorously than restrictions on sales. Moving more than two bags of maize requires a permit, and the police are likely to interfere with persons carrying even one bag (Booker International 1983, 9). Carrying any maize across district boundaries requires a permit, and permits for large amounts are issued only rarely. Unquestionably, some illegal private movement of maize takes place in the country, but recent market price data indicate that the amounts being shipped long distances are not sufficient to arbitrage price differentials. As shown in Table 1, in September of 1984, during a good harvest in Western and Nyanza provinces and a period of very short supply in Eastern and Central provinces, local market prices for maize in Eastern and Central were two to three times as high as they were in the west. In some cases, the differences were over $200 per ton,[8] which is much higher than the transportation costs.

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[4] This study argues that price stability *is* a goal of the Kenyan government, and consequently it is included in the government objective function. There has been considerable discussion in the welfare economics literature concerning whether or not price stability *should be* a goal of the government. The seminal articles in this literature are Waugh 1945; Oi 1961; Massell 1969; Samuelson 1972; and Turnovsky 1978.

[5] For a recent paper on seasonal and regional shortages, see Kleist 1985.

[6] Kenya's agricultural sector is neither described nor analyzed here. The best study is still Heyer, Maitha, and Senga 1976. For a much more complete review of the maize marketing system than the one presented here, see Booker International 1983.

[7] See Jabara 1984 for a description of the price review process.

If the board actually functioned in the way the law is written, these private market prices would not vary much more than the difference between NCPB buying and selling prices, even in times such as September 1984. The market would have a competitor in the NCPB, but the government has not given the board the fiscal resources necessary to accomplish this task. The NCPB has responded by not buying all the maize available in bumper crop years and by selling less than market demand in scarce years. Goldman (1983) has shown econometrically that the NCPB's buying and selling behavior is influenced by its available stocks. Private market prices such as those in Table 1 confirm this analysis.

These conclusions are reinforced by several studies of the marketing system in Kenya. Schmidt (1979, 65) found that in times of plenty the board forced prospective sellers to line up for days before taking delivery and sometimes would pay less than the official price. On the other hand, in deficit areas in times of scarcity very little would be sold. Hesselmark and Lorenzl (1976, 176-177) conclude their study of maize marketing by lamenting that the board "seems not to be able to reach producer price stabilization in surplus areas. . . [and] does not reach its objective of consumer price stabilization in rural deficit areas."

Such problems have led some observers to condemn the NCPB for inefficiency and corruption. While the studies mentioned above and a recent study commissioned by

Table 1—Rural market maize grain prices, September 1984

Market	Province	Price	Ratio to Bondo Price	Difference	Transport Cost from Bondo[a]
		(KSh/kilogram)		(US$/metric ton)	
Embu	Eastern	5.00	3.0	221	38
Kiambu	Central	4.22	2.5	169	27
Luanda	Western	2.13	1.3	29	4
Mumias	Western	1.94	1.1	17	6
Bondo	Nyanza	1.69	1.0	0	. . .

Sources: Based on data from Kenya, Ministry of Agriculture, Development Planning Division, "A Summary Report of the Food Situation as of 31 October 1984," Ministry of Agriculture, Nairobi, November 1984 (mimeographed); data for transport costs from Bondo derived from Michael Schluter, *Constraints on Kenya's Food and Beverage Exports,* Research Report 44 (Washington, D.C.: International Food Policy Research Institute, 1984), p. 63.

Note: An exchange rate of KSh 15.00 = US$1.00 is used here.

[a] Schluter's estimates of operating costs for a 7-ton truck in 1982 are increased by 40 percent to account for inflation (the CPI increased 31 percent during this period) and an additional 20 percent to allow for normal profit.

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[8] The $ symbol refers to U.S. dollars throughout this report.

the World Bank have shown that the board is not the most efficient of organizations, it is important to understand that it has been assigned an impossible task (Booker International 1983). The board is supposed to buy whatever is offered at a price over which it has no control; to sell whatever is demanded at a second price over which it has no control; to export and import only when given approval by the cabinet, not when it seems profitable to do so; and to store whatever the result of all these other decisions requires. Even an exceptionally efficient organization could be forced to lose money when operating under such constraints. The board's bending of the law by allowing stock levels to influence its buying and selling operations is understandable.

Government policy, then, must be distinguished from government pronouncements. In Kenya, as elsewhere, "most farmers have learned by painful experience that simple statements of government intentions to stabilize prices—or even to require them by law—are ineffective" (Timmer, Falcon, and Pearson 1983). The government claims to provide complete price stability to its consumers and producers, but the evidence presented above clearly shows that this is not the case. Because the pronouncements about price stability are unworkable, given the fiscal constraints of the NCPB, and since the foreign-trade decisions are out of its hands, the board is forced to buy and sell in ways that produce considerable price variability for consumers in rural deficit areas and producers in rural surplus areas. Thus maize prices in many rural areas are determined more by parastatal officials trying to keep their corporation solvent than by senior decisionmakers weighing one goal against another.

The government's official policy is to set the price at which maize will be sold long before the size of the crop can be estimated, with real prices being almost constant from year to year. Yet simple accounting identities show that if prices are to remain constant in real terms while production is variable, either the stock level or the foreign-trade account or both must absorb the instability. Another option that may appear to work is to limit NCPB sales or purchases by quantitative restrictions. All of these methods have been used in recent years. In 1979/80, government stocks decreased almost to zero, maize was imported, and the NCPB did not sell all that was demanded from it at the official price.[9] The situation in 1984/85 was similar, although government stocks had opened the market year at a much higher level and consequently were above 100,000 tons when the imports began to arrive. Conversely, in 1981/82 stocks were increased substantially, exports were approved (after a lag), and the NCPB did not buy all the maize that it was offered.

The quantitative restrictions, however, do not truly limit price instability because of the large percentage of maize that is bought and sold in private markets. While such restrictions allow the government to continue to buy or sell maize at the controlled price, they lead to large increases in local market prices (or decreases in years of abundant maize), thus causing price instability for rural consumers and producers.[10] So the only tools that successfully control price stability for all market participants are trade and storage policies. Historically, then, the goal of real price stability has been met only through the facade of stable official prices, while fluctuations in local market prices have been large.

The logical recommendation under such conditions is to add some flexibility to the official policy. For many years, a number of analysts have recommended freeing the marketing system in one way or another, most often arguing for a buffer stock scheme that would allow prices to fluctuate within a band. The Maize Commission of Inquiry discussed the issue in 1966 (Kenya 1966, 22). More recently, Gsaenger and Schmidt (1977) and Schmidt (1979) have argued that the NCPB should not play a primary marketing role but should hold buffer stocks and a strategic reserve.

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[9] "Where the Maize Really Went," *The Standard* (Nairobi), July 2, 1980.

[10] Bates (1981) argues that food policies in Africa have tended to favor the urban market for political reasons. This is less true in Kenya than elsewhere (see Jabara 1986; Meilink 1985).

It was in this context that the government appointed an Inter-Ministerial Working Group to study proposals for reforming the maize marketing system in 1983. This working group, of which the author was a member, developed a simulation model of the price band/buffer stock schemes that were being proposed at the time (Kenya 1983a). The policies under consideration would have caused the marketing system to be more flexible by making three changes: (1) decision rules for foreign trade would be approved ahead of time by the cabinet, so that each specific trade would not be delayed by cabinet deliberations; (2) movement controls would be relaxed to allow the private sector to accomplish what the NCPB has been unable to do historically—integrate the maize market across regions; and (3) prices would be allowed to fluctuate within a band, so that producers and consumers would bear some of the consequences of unstable production.

The working group was concerned with rationalizing the present system (changes 1 and 2) and investigating the benefits of allowing prices to fluctuate (change 3). The simulation models conducted by the working group assume that the first two changes are made and then attempt to measure the trade-off between cost and price flexibility in a dynamic, stochastic framework. The report clearly shows that much lower fiscal costs are possible when prices are allowed to fluctuate.

The analysis in the present study will begin in the next chapter by discussing the appropriate methodological approach, starting with the simulation methods used by the working group. Readers whose primary interest is in the policy conclusions may wish to skim this chapter. The model is developed in Chapter 4, with results presented in Chapter 5.

3

METHODOLOGICAL APPROACH

The Analytical Context: Simulation and Optimization

The Inter-Ministerial Working Group appointed in 1983 to study marketing reform proposals used a simulation approach to measure the costs of different policy options. The two parameters that determine this type of price band/buffer stock scheme (these are defined explicitly in the following section) are varied and tested in a large number of possible 10-year production cycles. It is necessary to make annual production stochastic, since the underlying nature of the problem is instability in production. Including 10 years in each cycle allows the model the opportunity to test for performance of the policies in sequences of good and bad years. This dynamic component is necessary to test different strategies for stock carry-outs.

Each of the three objectives—price stability, fiscal cost, and imports—is measured over the 10-year cycles for every variation of the policy parameters, thus defining a set of feasible combinations of the objectives. Trade-offs between pairs of objectives are then calculated by holding the third objective constant. These trade-offs will be accurate reflections of the cost of increasing the level of each objective, provided the underlying model is sufficiently realistic and *the price band/buffer stock schemes are the most efficient policies for meeting the three government objectives.*

There are reasons for suspecting that such schemes are inefficient. In a closed economy with a somewhat different objective function, Newbery and Stiglitz (1981) have shown that price band policies are quite inefficient. Since the government tools in the price band scheme do not respond to changes in the world price, it would seem that these policies may be even less efficient in an open economy. This consideration alone suggests that there are alternative policies that are more efficient and might yield a different measure of trade-offs because they flexibly adjust to states of the world.

There are two alternatives for measuring trade-offs accurately: modify the price band policies to make them more flexible to state parameters such as the world price; or set up an optimizing model that chooses the best level of the government control variables for each possible state of the world, and then simulate the chosen policy.

Although optimizing is bound to be more difficult, there are four reasons for using an optimization method rather than simply simulating additional chosen policies. First, since there is a potentially infinite number of possible policies, the choice of which ones to simulate will be to some extent ad hoc. As Eaton (1980) points out, when simulating different types of administrative rules "we cannot know whether an untested solution exists which better achieves the stated goals. Optimization is the preferred mode of analysis for screening many alternatives."

Second, optimization ensures that the trade-offs between objectives are measured accurately. When optimizing a multidimensional objective function, trade-offs between objectives are measured by varying the weights on the different objectives (Blandford and Lee 1979). Different weights on the three government objectives will force the optimizing algorithm to choose different policies. If the weight on minimizing imports is increased, for example, optimization ensures that the policy is adjusted in such a way that the cheapest method of reducing imports has been chosen.

Parts of this chapter appeared in Pinckney 1986b, 451-466.

Third, finding the optimal policy allows for measurement of the degree of suboptimality of alternative policies. Once the optimal policy for a given set of weights is found, it can be simulated in the same way as a price band/buffer stock scheme, thus allowing a direct comparison between the two types of policies. This is especially important for policy recommendations, since administrative rules generally are easier to understand and implement than the policies that come out of optimization routines. Yet ease of communication and implementation is an objective of the government that is difficult, if not impossible, to build into the optimizing process. Once the optimal values of the objectives are known, the values of the objectives produced by the administrative rules can be compared, and a trade-off between complexity and cost can be computed.

Fourth, differences between the way the optimal policies and the administrative rules respond to the state of the world can be studied, and the administrative rules can be adjusted in ways suggested by the optimal policies. This should make possible both reductions in the complexity/cost trade-off and the formulation of an administrative rule that is much more efficient than one that would have been tested without considering the optimal policies.

Thus there are several potential benefits of using optimization techniques. The costs, however, in terms of program development and analysis are considerably larger for optimization routines than for simulation of administrative rules. This study will use optimization methods and consider in conclusion whether or not the benefits gained from their use outweigh the costs.

Defining the Price Band/Buffer Stock Policies

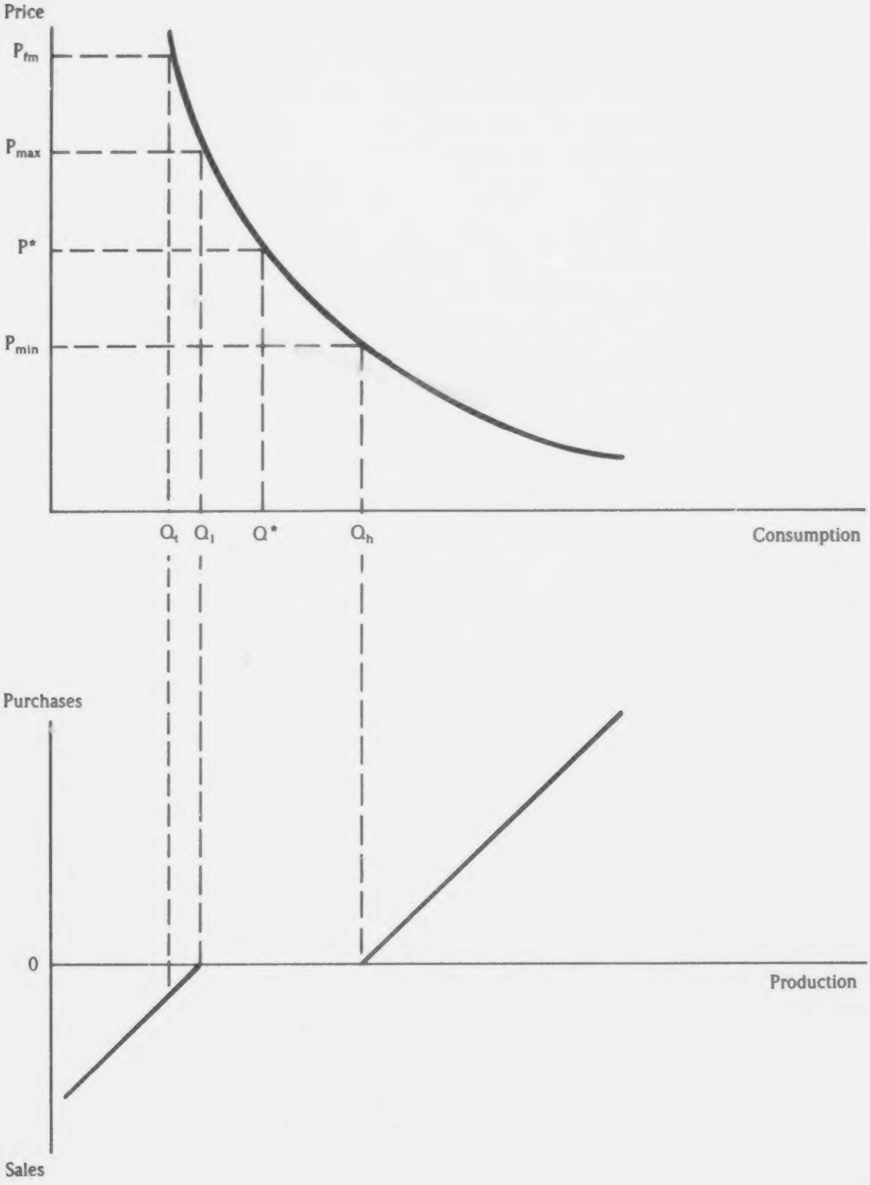
The basic price band/buffer stock policies studied by the Inter-Ministerial Working Group are described in this section. For brevity, these policies will be termed "price band policies" in what follows. It is assumed that the government has a target price, P^*. A maximum price is set, P_{max}, at which the government promises to sell sufficient quantities of maize to meet demand. Similarly, a price, P_{min}, is set, at which the government will buy all the maize which it is offered. Between P_{min} and P_{max}, prices are allowed to fluctuate freely. Two graphs (Figure 1) can help explain the basic policy. In the top graph, P_{max}, P^*, and P_{min} are drawn on the Y-axis. Each of these prices corresponds to a quantity consumed on the X-axis. Now suppose that actual production in year t is Q_t which corresponds to a free market price, P_{fm}, greater than P_{max}. The government would have to sell $Q_l - Q_t$ in order to keep the price at or below P_{max}.

The lower graph shows the relation between production and government purchases under such a system. The board buys all that is produced above Q_h, and makes up the total difference between Q_l and actual production. This graph will be particularly helpful later on when comparing price band policies with those that result from optimizations.

How should these three prices (P^*, P_{min}, and P_{max}) be chosen? The government does not want stocks to grow year after year or to be depleted continually. Price band/buffer stock schemes may be useful for stabilizing prices from year to year but are unlikely to be successful if the government is trying to raise or lower long-run market prices. So the working group takes P^* to be the free market price during a normal weather production year, and chooses the logarithms of P_{min} and P_{max} to be symmetrically distributed around the logarithm of P^*. This is approximately equal to holding the price within equal percentage bands.

The rules for exporting and importing are more difficult to choose. In the past, Kenya has allowed its own stock position to determine whether or not trade should

Figure 1—Net purchases function implied by price band policy


Price
P_{fm}
P_{max}
P^*
P_{min}
Q_t
Q_l
Q^*
Q_h
Consumption
Purchases
0
Production
Sales

take place. Another alternative would be to allow imports and exports at other times if prices warrant it, or to adjust the stock triggers, depending on the prevailing world price. The working group simulations follow past government practice and allow stocks alone to trigger trade. The price band schemes therefore have minimum and maximum stock figures, S_{min} and S_{max}, which serve as trigger points for foreign trade. Since imports will not arrive in Kenya until three or four months after orders are placed, the S_{min} should be greater than zero. For the purpose of dealing with production instability, however, the important parameter of the model is not S_{min} or S_{max} but $(S_{max} - S_{min})$, the difference between maximum and minimum stock levels. This difference will be termed "stock variability." The purpose of stocks in a dynamic, stochastic world is to absorb shocks in present production and move grain from a surplus time period to a deficit time period. The degree to which stocks are able to accomplish this task is determined by the stock variability, not by S_{min} or S_{max} in isolation from each other.

This is seen most clearly by considering an example. Policies with larger stock variabilities will have higher average stock levels, lower imports, and lower exports. But the difference between two policies with the same figure for stock variability is only a constant. Suppose that policy A imports at a stock level of 100,000 tons and exports at 400,000 tons, and policy B imports at a stock level of 200,000 tons and exports at 500,000 tons. Both policies, then, have a stock variability figure of 300,000 tons. But the only difference between these policies when simulated will be the net present value of storing 100,000 tons for the entire time period, assuming that policy B begins with 100,000 tons more in store than policy A. This figure is a constant. Imports and exports will be identical, and average stock levels will only differ by 100,000 tons. Thus the single parameter of stock variability is required to determine the policy rather than two separate stock triggers.

So, given that P* is constant across policies and that the price bands are symmetric, the price band policies studied by the working group differ only in two parameters: the allowable price variability and the stock variability.

The simulation model of the price band schemes is similar to the country models developed by Reutlinger and Bigman and Abbott's proposed methodology (Reutlinger 1983; Reutlinger and Bigman 1981; Reutlinger, Eaton, and Bigman 1976; Bigman 1982a, 1982b, 1985; Bigman and Reutlinger 1979a, 1979b; Abbott 1985). There are significant differences, however, between their models and the ones used here and by the working group. The Bigman and Reutlinger models are used primarily to measure the efficacy of implementing one type of policy versus another type, such as relying on trade to stabilize supplies versus relying on buffer stocks. Also, while they attempt to build their models for a generic country, it is obvious that any results will be particularly dependent on the specific parameters and policy structure chosen. Many of the published results use parameters relevant to India, including modeling a ration shop system similar to the one in use in that country. Kenya's status as a marginal importer and exporter with large differences between import and export parity prices makes its situation considerably different from the countries modeled in their publications. Finally, the goal of measuring the trade-offs between government goals leads to a different type of analysis than one focusing on choosing one type of policy over another.

Choice of Optimization Technique

There are at least three optimization techniques that have been used to analyze storage problems in the literature. These are Bigman's method, Eaton's programming method (Eaton 1980), and stochastic control methods (Rausser and Hochman 1979;

Kim, Goreux, and Kendrick 1975; Kendrick 1981; Arzac and Wilkinson 1980) or dynamic programming.[11] They will be considered in order.

Bigman has developed a technique that finds the optimal price band/buffer stock policy (Bigman 1985; Bigman and Yitzhaki 1983). If the government has already decided that a policy of this type is to be implemented, this is a useful technique. Otherwise, there could be a more efficient policy that does not fit into this category. Thus, in the absence of government direction in the matter, this technique cannot yield the four benefits outlined above.

Eaton's method requires that the problem be formulated with a quadratic or linear objective function and linear constraints (Eaton 1980). Production must be characterized as a random variable that is not influenced by the endogenous government decision variables. Thirty or more sequences of, say, 10 years each of possible future production are then produced by a random number generator. A series of multiperiod quadratic programming problems are then formulated, one for each 10-year production sequence, with the level of production for each year entering as a constraint. The quadratic programming results give optimal levels of the control variables for each particular future production sequence. The control variables clearly will be different for each production sequence and are chosen by the model with full knowledge of future production. It is as if Eaton acknowledges that this is unrealistic, since the model is making use of facts that would be unknown at the time decisions are made. However, he suggests that more general optimal policies can be gleaned from these particular implementations by regressing the levels of the control variables on values of other control and state variables that are known at the time decisions would have been made.

The problem with this technique is that the best specification of the regression equations is unknown. Given the results of the quadratic programming problems, it is difficult to move ahead. Should only linear decision rules be considered? Will the relationship between, say, carry-out stocks (the amount of stock held at the end of a market year—in this report, total stocks minus the import cushion) and production be the same for high levels of production as for low? That is unlikely, but it is unclear what levels of production should be included in the regression. So Eaton's method is not a true optimization method, since there is no way to guarantee that the optimal specification for policy structure has been tested in the regression analysis. Thus, it cannot yield the four benefits listed above.

Stochastic control methods leave no question about optimality if prior conditions are satisfied. Solving the continuous optimization problem by calculus techniques, however, is notoriously difficult. Kim, Goreux, and Kendrick (1975) are unenthusiastic about recommending this technique to other researchers dealing with storage problems, as they conclude their article by admitting that they cannot be certain their computations are correct. So if control methods are to be useful, they will have to be simplified in some way.

There are at least two ways of simplifying the problem: using certainty equivalence methods or using dynamic programming. Theil (1957) has shown that a stochastic control problem with a quadratic objective function and linear state transition equations has a certainty equivalence solution; that is, the variability of the stochastic variable makes no difference in the choice of the optimal policy. If the problem can be stated in those terms, the solution can be found simply by filling in the values of some variables in an equation.

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[11] Bellman 1957 is the classic presentation. Howard 1960 concentrates on the Markov chain methodology, which is employed for world prices in this study. In the area of optimal stockholding, Gustafson (1958) was the pioneer. Gardner (1979) and Burt, Koo, and Dudley (1980) use dynamic programming in more complex models. Gardner 1979 and Plato and Gordon 1983 are particularly useful for the practitioner. Johnson (1981) and Johnson and Sumner (1976) attempt to apply dynamic programming to stockholding problems of LDCs. The manual for the Microsolve program (Jensen 1983) is especially helpful for composing a computer program to solve such a problem; it is also an excellent teaching tool.

The Kenya model that will be used here has a quadratic objective function and could have been constructed with a linear demand curve, allowing for this solution technique. But consider the following implications of certainty equivalence: Suppose there are two countries, each with an average production of 10 million tons. In one, the standard deviation of production is 5 million tons, while in the other the standard deviation is only half a million tons. If certainty equivalence is correct, provided both countries have the same opening stock and the same production, and face the same world price, then they should carry out the same stock despite the large difference in the standard deviations. This is counterintuitive.

It is also incorrect. The problem is that the derivation of the certainty equivalence theorem assumes that there are no inequality constraints. But stocks, imports, and exports are all strictly non-negative variables (because of the difference between import and export parity, imports and exports must be costed differently and thus must remain distinct rather than being added together as trade). Such non-negativity conditions make the certainty equivalence formulation unworkable.

In spite of these problems, Arzac and Wilkinson (1980) have developed a storage model for grains that uses certainty equivalence methods and compared their results to those from the pioneering dynamic programming work of Gustafson (1958). They comment that "the numerical [dynamic programming] solution and the linear rules [from the certainty equivalence formulation] give very similar results for stocks greater than or equal to 35." This statement is correct (except that 35 should refer to total supply rather than stocks). But Gustafson goes on to compute his model for different levels of production variability, and he gets considerably different results with a higher level of variability. The certainty equivalence formulation gives the same result for every level of variability, since it ignores the standard deviation of production. Table 2 shows the level of total supply (production plus opening stocks), Gustafson's results with a low variability of yield, his results with a high variability of yield, and the Arzac and Wilkinson certainty equivalence results.

Most striking are the negative stock levels with a total supply of 25 and 30 in the certainty equivalence results. The authors claim that the "negative stocks produced by

Table 2—Optimal storage versus certainty equivalence storage

Total Supply	Optimal Storage		Certainty Equivalence Storage
	Low Variability	High Variability	
25	0.0	0.0	−4.5
30	0.0	0.0	−1.1
35	2.4	2.9	2.3
40	5.9	6.4	5.6
45	9.7	10.2	9.0

Sources: Based on data from Enrique R. Arzac and Maurice Wilkinson, "Dynamic Analysis and Optimal Control of Agricultural Commodity Markets," in *Applied Stochastic Control in Econometrics and Management Science*, ed. Alain Bensoussan, Paul Kleindorfer, and Charles Tapiero (Amsterdam: North Holland Publishing Company, 1980), pp. 41-77; and Robert L. Gustafson, *Carryover Levels for Grains: A Method for Determining Amounts That Are Optional Under Specified Conditions*, Technical Bulletin 1178, U.S. Department of Agriculture, October 1958.

the linear rules can be interpreted as a reduction in the working stocks of the economy (which are implicit in this analysis)" (Arzac and Wilkinson 1980, 46). But this is surely not a proper interpretation, since there is no mechanism for the buildup of working stocks in the model.

They also suggest that the certainty equivalence solution with stocks truncated at zero "seem[s] to produce a very good approximation to the numerical solution" (Arzac and Wilkinson 1980). While not far off for Gustafson's original case, it is considerably off for Gustafson's case with a larger variance, and Gardner (1979) cites an example in which the certainty equivalence stock level is only about 50 percent of the dynamic programming stock level. Clearly, it is fortuitous that the particular case Arzac and Wilkinson cite turns out to be close. It is thus wrong for an analyst to assume a priori that the certainty equivalence solution will be close to the dynamic programming solution. In fact, Gardner (1979, 17) makes the point that the

> use of optimal control methods which substitute the expected value of future production for the probability distribution of production can lead to recommended carryover stock levels substantially lower than the optimal carryover. Indeed, in almost every practical application, optimal storage increases significantly as the variance of future production increases.

It is clear, then, that certainty equivalence methods are not appropriate for the analysis at hand.[12]

The second possible simplification of the stochastic control problem is dynamic programming. This involves making the problems discrete rather than continuous and solving by means of a backward recursion. The algorithm is best understood by a simple example.[13] Suppose there is a country where production is either 8 or 12 units every year, with the two outcomes being equally likely. Storage capacity is 3 units and everything that is not stored is consumed. The cost function to be minimized is

$$\Sigma(C_t - 10)^2 + 0.1 \cdot S_t$$

for all years t in the time horizon, where C_t represents consumption in year t and S_t represents closing stocks. Say there are T years in the time horizon. Dynamic programming generally uses a backward recursion technique to solve the problem. Beginning with the terminal year T, all possible opening states of the world are enumerated, each one being evaluated for all of the possible stock carry-outs. This is shown in Table 3.

Consider the first row of the table: if production is 8 and there are no carry-in stocks, then carrying out no stocks implies consumption of 8 and thus a cost of

$$(10 - 8)^2 + 0.1 \cdot 1 = 4.0.$$

Storing 1 unit implies consumption of 7, leading to a cost of

$$(10 - 7)^2 + 0.1 \cdot 1 = 9.1.$$

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[12] Control methods are most useful and interesting when the systematic variations from period to period are significant, making the nonstochastic case nontrivial. Then certainty equivalence methods can be used to approximate a solution, and the stochastic case can be solved by minimizing deviations from the certainty equivalence case. This is the technique used by Kim, Goreux, and Kendrick (1975).

[13] Gardner (1979, 5-14) gives a more detailed example of a similar problem.

Table 3—Dynamic programming example: terminal year payoffs

Production	Opening Stocks	Cost if Closing Stock Is 0	1	2	3	Minimum Cost
8	0	4.0	9.1	16.2	25.3	4.0
8	1	1.0	4.1	9.2	16.3	1.0
8	2	0.0	1.1	4.2	9.3	0.0
8	3	1.0	0.1	1.2	4.3	0.1
12	0	4.0	1.1	0.2	1.3	0.2
12	1	9.0	4.1	1.2	0.3	0.3
12	2	16.0	9.1	4.2	1.3	1.3
12	3	25.0	16.1	9.2	4.3	4.3

The rest of the table is computed in a similar fashion, with the cost of the best stock option shown in the right-hand column.

That completes the analysis for the terminal year T. Now, consider the situation in year T–1. Since the objective function is the same, the cost in year T–1 alone of storing a particular quantity, given opening stocks and production, will be identical to the values computed for year T. However, the total cost in year T–1 is the sum of the cost in year T–1 plus the expected future cost in year T. These total costs are computed in Table 4 for the state in which production is 8 and carry-in stocks equal 2 in year T–1.

Consider the first row of the table. Table 3 shows that the cost in year T–1 of carrying out zero stocks when production equals 8 and opening stocks are 2 is zero. But if no stocks are carried out in year T–1, then there are two possibilities for year T shown in Table 4: either production will be 8, with a cost of 4.0, or production will be 12, with a cost of 0.2. Since those outcomes are equally likely, the expected cost in year T of carrying out zero stocks in year T–1 is 2.1. The best choice, then, is to consume 9 units and store 1, with a total expected cost of 1.75. Note that when only one year is considered, it is optimal to consume all of production and stores when production is 8 and stores are 2, but when the subsequent year is considered, it is best to consume less in the present year and store 1 unit.

To complete the dynamic programming recursion, similar tables would have to be computed for the other seven possible states of the world in year T–1. Each table would yield the cost of being in that state of the world in year T–1. Then the recursion would move back to year T–2 and proceed in a similar fashion until year 1 is reached.

It is clear from this example that dynamic programming can solve dynamic, stochastic problems similar to Kenya's maize-marketing problem. Dynamic programming has the additional advantage of allowing inequality constraints on the variables. The constraints

Table 4—Dynamic programming example: year T–1 payoff calculations

Carry-out	Cost in Year T–1	Cost in Year T If Production = 8	Production = 12	Expected Cost in Year T	Total (T–1 + T)
0	0.0	4.0	0.2	2.10	2.10
1	1.1	1.0	0.3	0.65	1.75
2	4.2	0.0	1.3	0.65	4.85
3	9.3	0.1	4.3	2.20	11.50

Note: Production = 8; carry-in stocks = 2.

do not have to be linear, so unlike Eaton's method or certainty equivalence techniques, a nonlinear demand curve can be used. In fact, a limitation of this approach is that as a discrete system, inequality constraints are required on every variable. Thus it is difficult at times to ensure that the results are not constrained by inequalities that are a function of the particular specification of the solution algorithm rather than of the theoretical model.

Before accepting dynamic programming as the proper technique for this study, it is necessary to consider the two charges that other analysts have brought against it. These are the need for a simplistic objective function, and the "curse of dimensionality."

Although the example considered above is very simple, the criterion for optimality in most applications of dynamic programming to storage problems has not been much more complex than the one used there. As Bigman and Yitzhaki (1983, 2) point out, these functions have generally been "a single valued social welfare function (generally, the sum of the present and the expected future consumers' and producers' surplus)." Indeed, Eaton (1980, 20) points out that maximizing producer/consumer surplus after subtracting costs of storage "has been the sole objective of dynamic programming analyses of grain reserves." Cochrane's (1980) critique of such an objective function is only the best known of many others.

The use of simplistic objective functions, however, has been the result of researchers' choice, not a requirement of the solution technique. The solution algorithm used in the present study is simply a brute-force search; this is slow computationally, but it is effective in dealing with the three objectives, with nonlinear costings, and with a nonlinear objective function. Importantly, all the programs can run on microcomputers, so the costs are not excessive.[14] Consequently, there is no need to avoid dynamic programming because of the need for a complex objective function.

The second problem with dynamic programming is the curse of dimensionality (Bellman 1957). This problem multiplies in difficulty with the number of possible states of the world in the model. As an example of the effects of the curse, consider the model to be developed below. The state of the world will be determined by three variables: world price, production, and opening stocks. Nine discrete levels of production and 30 discrete stock levels are allowed. If these were the only two state variables, there would be 9 × 30 = 270 possible states of the world. By adding one more variable, world price, with 7 discrete levels, there are now 7 × 9 × 30 = 1,890 possible states of the world. The problem has increased more than sevenfold in terms of computing time. The curse consequently constrains the size of the model that can be developed. To some extent, this constraint can be relaxed by using larger computers or more efficient solution techniques.[15]

The curse is not a major problem for this study. As discussed in the next chapter, data problems and the desire to keep the model understandable would have led to a fairly simple model even if a different solution technique had been used.

Thus dynamic programming is clearly the best choice of optimization technique for the problem at hand. Each of the four benefits of optimization mentioned above—

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[14] Programs are listed in Pinckney (1986a). Recent versions of both programs are available from the author in Microsoft Fortran 4.0.

[15] Burt, Koo, and Dudley (1980) use a solution technique that is not a backward recursion. Their method allows other variables from a more complex econometric model to influence the expected value of future costs. The disadvantage is that expected values are no longer exact, as they are when a backward recursion algorithm is used. Nevertheless, this technique is interesting and warrants further research in countries where data limitations do not rule it out.

making selections across many types of policies, measuring trade-offs accurately, maximizing the value of the objective function for comparison with suboptimal policies, and providing suggestions for modifications of administrative rules—is gained through the use of dynamic programming.

In order to take advantage of the last three benefits, however, it is necessary to take the analysis one step beyond the optimization algorithm itself. As mentioned above, the optimal policies must be simulated in the same framework as the price band schemes in order to compare measurements of trade-offs, to judge the suboptimality of the price band schemes, and to learn from the optimal policies in order to adjust the price band schemes. Before the optimal policies can be simulated, however, they need to be made "continuous" rather than discrete. This is accomplished by linearly interpolating the discrete optimal policies across state variables. While it is unlikely that the resulting policy will be the optimal continuous policy, it will not be substantially different if the discrete optimization includes a large enough number of levels of each state variable. This is discussed more fully in the following chapter.

4

A PRODUCTION INSTABILITY MODEL FOR KENYA

Food Production and Consumption Data in Kenya

In a review of the problems associated with formal analyses of food security issues in East Africa, Lele and Candler (1981, 105) warn against "planning without facts," and go on to say

> We do not believe that the exercises of economists in the international agencies are inherently futile; but we do warn that such analyses should not start with the facile assumptions that all the required data are readily available and that the system is totally commercial.

The quality of data on both food crop production and consumption in Kenya is poor. The only hard data available are on purchases and sales of grains by the NCPB, but these series are inappropriate for use as proxies for total production. The presence of the parallel, informal market as a competitor to the board causes the NCPB to take a larger proportion of the crop during good production years than in poor production years, since the ratio of the local market price to the official price varies. Consequently, NCPB purchases and sales fluctuate much more dramatically than production.

Yet if the NCPB numbers are inaccurate indicators of production, which production series should be used? The Kenyan government publishes several conflicting series, and others are available from international organizations. Table 5 presents the series used by the Development Planning Division of the Ministry of Agriculture (DPD/MOA) along with the series from the Food and Agriculture Organization of the United Nations (FAO) and the U.S. Department of Agriculture (USDA). For comparison, the NCPB sales and purchases data are listed also.

There are large differences between the series, most obviously in 1976/77 when the FAO series shows an increase of over 60 percent, the USDA shows an increase of over 15 percent, and the DPD/MOA series increases less than 1 percent. The figures show smaller differences between these series in recent years.

The DPD/MOA series is built up from district and provincial estimates of maize production made by Ministry of Agriculture officers in the districts. Goldman (1983) uses the provincial estimates to test for links between NCPB sales and purchases series and the production series. He estimates the following equations:

$$\text{BUY} = 205 + 0.53\ \text{RIFT} - 0.85\ \text{OPENSTOCK}$$

Years: 72-82;
Adjusted $R^2 = 0.93$,

$$\text{SALES} = 0.15\ \text{INVENT} - 0.75\ \text{WEST} - 1.45\ \text{EAST}$$

Years: 71-73, 75-81;
Adjusted $R^2 = 0.61$,

where

BUY = NCPB purchases,
SALES = NCPB sales,
RIFT, EAST = production in those provinces,
WEST = production in Western and Nyanza provinces,
OPENSTOCK = NCPB opening stocks, and
INVENT = opening stocks plus current year's purchases.

All t-statistics are significant at the 2.5 percent level.

These equations give strong support to the DPD/MOA production series, since they relate the building blocks of that series to the only hard data available. Unfortunately, it is impossible to compare the competing series by comparable tests, as those data are not reported by province. Nevertheless, because the DPD/MOA series is supported it will be used in the analysis at hand.

On the consumption side there is no series that exhibits any links with hard data. The DPD/MOA production series is at least a direct estimate of the desired quantities, albeit by people of varying levels of skill and interest. The best consumption series, on the other hand, is a derived series that leaves out a critical variable: changes in private stocks. Table 6 shows the derivation of an apparent consumption series for the last 15 years.

The series is nonsensical when considered as "consumption." It can more appropriately be called "disappearance." The problems are most obvious for 1975/76, 1981/82, and 1984/85; the first two were good crop years after relatively poor ones had

Table 5—Different series of maize production in Kenya

Year	DPD/ MOA	USDA	FAO	NCPB Purchases	NCPB Sales
			(1,000 metric tons)		
1970/71	1,181	1,500	1,400	240	278
1971/72	1,473	1,300	1,500	379	191
1972/73	1,384	1,700	1,660	455	358
1973/74	1,297	1,600	1,600	335	490
1974/75	1,387	1,600	1,400	448	343
1975/76	1,688	1,900	1,600	552	604
1976/77	1,748	2,195	2,600	536	397
1977/78	2,080	2,205	2,553	244	146
1978/79	1,740	1,895	2,169	235	513
1979/80	1,604	1,450	1,800	131	491
1980/81	1,768	1,750	1,620	393	685
1981/82	2,502	2,200	1,980	696	532
1982/83	2,348	2,340	2,349	621	473
1983/84	2,030	2,000	2,178	504	768
1984/85	1,423	1,275	1,275	366	803

Sources: Based on data from Food and Agriculture Organization of the United Nations, *FAO Production Yearbook*, various issues (Rome: FAO, various years); U.S. Department of Agriculture, Economic Research Service, *World Indices of Agriculture and Food Production*, Statistical Bulletins 669 and 710 (Washington, D.C.: USDA, July 1981 and July 1984); U.S. Department of Agriculture, Foreign Agriculture Service, *Foreign Agriculture Circular, Grains: World Grain Situation and Outlook* (FG-2-85) (Washington, D.C.: USDA, 1985); and unpublished data from the Development Planning Division, Ministry of Agriculture, Nairobi.

Notes: Figures are for crop years, July to June. DPD/MOA = Development Planning Division/Ministry of Agriculture; USDA = U.S. Department of Agriculture; FAO = Food and Agriculture Organization of the United Nations; and NCPB = National Cereals and Produce Board.

Table 6—Derivation of maize "consumption" series

Year	Production	NCPB Net Sales	"Consumption"
		(1,000 metric tons)	
1970/71	1,181	38	1,219
1971/72	1,473	−188	1,285
1972/73	1,384	−97	1,287
1973/74	1,297	155	1,452
1974/75	1,387	−105	1,282
1975/76	1,688	52	1,740
1976/77	1,748	−139	1,609
1977/78	2,080	−98	1,982
1978/79	1,740	278	2,018
1979/80	1,604	360	1,964
1980/81	1,768	292	2,060
1981/82	2,502	−164	2,338
1982/83	2,348	−148	2,200
1983/84	2,030	264	2,294
1984/85	1,423	437	1,860

Source: Unpublished data from the National Cereals and Produce Board, Kenya.

depleted private stocks. Consumption shows a big jump, which is at least partially an increase in private stocks. For 1984/85, it is clear that private stocks were drawn down to make up for the production shortfall.

There is virtually no evidence about the magnitude of private stocks in the country. The Integrated Rural Surveys of the 1970s report figures for private stocks held by smallholders, but even these numbers are derived from numbers for production and consumption, since the survey questionnaire did not ask about stocks. As an example of the magnitudes involved (which should only be considered indicative), Integrated Rural Survey 3 estimates that in July 1977, private stocks held by small farmers were 132,000 tons; this figure increased to 203,000 tons by July 1978, implying that the consumption figure in Table 6 for 1977/78 should be decreased by 71,000 tons.[16] Since 1977/78 was the second good year in a row, this figure is unlikely to be abnormally high. In addition, since large farmers and traders are not included, it is clear that changes in private stocks might be quite large relative to the variation in the consumption series.

Given the problems caused by a lack of information on the demand side, it will be necessary to forgo any direct estimate of price elasticity of demand if this study is to avoid being lumped with the "mechanistic analyses of meaningless numbers" that Lele and Candler (1981, 107) criticize. In such a situation it is more reasonable to make judgments about the magnitude of some important parameters than to use data series that are known to be far from correct. The absence of hard data also affects the type of model that can be employed, as is made clear in the following section.

The Model

The purpose of a model is not to mirror the real world. The rationale for modeling is that the real world is too difficult to understand in its entirety, and the analyst can gain a better understanding of the forces at work by selecting certain aspects of the world to study in depth. There are two opposing motives for the analyst: first, the desire to include all the interactions that will affect significantly the goals of the model; second, the need to keep the model simple and understandable. A model that leaves out key relationships can cause the analyst to give incorrect advice; a model that tries to include too much can leave the analyst foundering "in a limbo of unending data requirements, impossible 'debugging' problems, and general ineffectiveness" (Clark, Jones, and Holling 1979, 7). The result of these problems can be a black box model that no one, including its builder, can understand or interpret (see Johnston and Clark 1982, 231-234).

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[16] Figures are from Booker International 1983, Annex 8, Appendix 1, Tables 8 and 9. In July of 1977 and 1978, government stocks were 400,000 and 490,000 tons, respectively, or more than double the IRS estimate of smallholder stocks. The IRS estimates, however, are suspect.

Clearly, balancing the two goals is an art and not a science. The point of balance will depend heavily on the goals of the analysis at hand. But as Holling (1978, 57) laments, "all too often, it is the technique that grabs the lead, and the problem is then bent and redefined to suit." Since one of the goals of this analysis is to have an effect on decisionmakers, it is even more important than usual to have a model that is clear and straightforward (Labys 1975, 372). This study, then, avoids the Charybdis of a black-box model by navigating rather close to the Scylla of a simplistic model.

Therefore, a simple model underlies both the simulation and the optimization procedures. For each equation the degree of simplicity is defended below. In some cases, a slightly different model is used in the simulation analysis than in the dynamic programming. These differences will be described also. Discussion proceeds by examining first the unified market assumption. This is followed, in order, by a discussion of supply, demand, the trade and stock equations, the world price equation, and the objective function. Then other types of objective functions are considered, followed by a description of the price band/buffer stock decision rules. Finally, the parameters of the model are selected in the final section of the chapter.

Unified Market

The maize market in Kenya is treated as one unified market in the simulation and optimization exercises. Since this assumption is made for simulations of future policy rather than estimation of parameters from past experience, the assumption does not imply that the Kenyan maize market has been fully integrated in the past. Table 1, which presents maize prices in different parts of Kenya in September 1984, clearly shows that markets have not been fully integrated. To a large extent, this lack of integration has resulted from an official government policy of totally stabilizing prices that the government cannot implement, given fiscal constraints. For example, in September 1984 the NCPB was not selling all that was being demanded at the official price. There has thus been a government-induced lack of integration.

This study is examining the cost savings to the government that result from providing the NCPB with sufficient fiscal resources to defend successfully floor and ceiling prices after building some official price flexibility into the system. Therefore the changes in policy being modeled here would lead to a higher degree of integration of the maize market, with prices in different markets differing by less than the width of the price band. It is thus appropriate to make the single market assumption for the purpose of designing a national supply stabilization strategy.

Nevertheless, prices will vary across the country and across seasons within the limits allowed by the policy. Consequently, an analysis that includes regions and seasons is important when deciding on the tactics of implementation of the supply stabilization strategy. This analysis, however, can be introduced into a 12- to 18-month model after the major decisions on strategy are made. Attempting to include regions and seasons in the multiyear model that is necessary for designing stabilization strategy would lead to unnecessary complications, obscuring the important lessons on policy design.

Supply

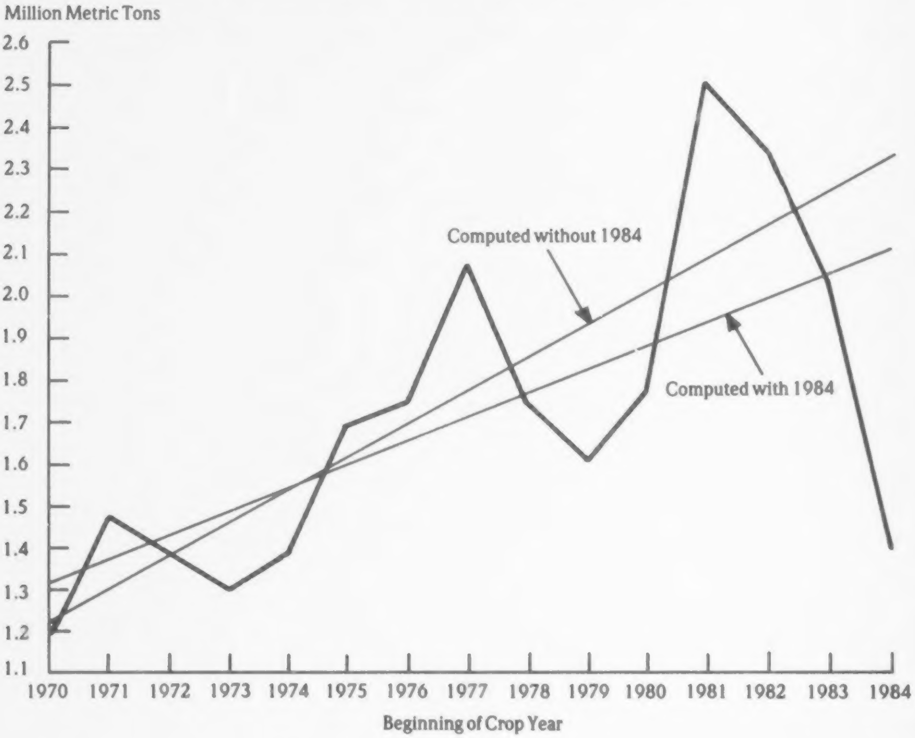
Production is modeled here as a stationary, normally distributed, uncorrelated time series:

$$Q_t = Q_0 + u_t, \tag{1}$$

where Q_t is production in year t, Q_0 is the mean, and u_t is the random element in year t. The random term u_t is normally distributed with an expected value of zero. Critics of this specification might focus on the following areas: maize production in Kenya has increased at a rapid rate over the last several years, so a series without a trend is inappropriate; an autocorrelation term should be included; the model ignores supply response to price; and although production can be modeled as a random variable, it is not normally distributed. These objections will be discussed in order.

Absence of a supply trend. It is undoubtedly the case that maize production in Kenya has grown rapidly in the last 15 years. Figure 2 shows the DPD/MOA production series for maize from 1970/71 to 1983/84. The less steeply rising line is the linear trend computed by regressing production on time for the entire period. This corresponds

Figure 2—Maize production and trends, 1970/71-1983/84



to a trend of about 3.3 percent at the mean production level for the period. The more steeply rising line is the trend computed from a regression that leaves out the 1984/85 drought year; it corresponds to growth of about 4.5 percent per year. Thus, although there is considerable area for disagreement about the magnitude of the trend, there can be no doubt that it is large and positive. A large component of this increase, however, has been area expansion, which is unlikely to increase as fast in the future. At the same time, there is considerable potential within the country to raise maize yields through better husbandry practices and development of improved varieties. So increases in production on the order of 3.5 percent per year over the next 10 years are not unreasonable to expect.

The expected growth in demand, however, is quite close to expected growth in production. Demand growth is affected primarily by three factors: population growth, growth in per capita income, and urbanization. Present population growth is 3.8-4.0 percent per year. Urban population is expected to grow at a rate of 7.8 percent per year. If per capita income remains approximately constant, maize demand will grow at about 3.5 percent per year, since the per capita consumption of maize in urban areas is only about 75.0 percent of the rural per capita consumption. Thus, given the rate of maize production increase and assumed rates of growth in demand, the real price of maize in a normal weather year should remain fairly constant. Since there is much uncertainty about the trend in maize production, and since the estimates of maize consumption are even worse, it is best to make a straightforward assumption about ignoring trends and consider any policy recommendations that come out of the analysis about stocks, for example, as relating to the percentage of a normal crop rather than an absolute number. This has the advantage of allowing the dynamic programming model to have the same structure every year, and thus come to a stable solution after several iterations. Although the absence of trends will make estimates of cost too low, it should not affect the measure of trade-offs between the goals, which is the primary purpose of the analysis.

Autocorrelation. Autocorrelation may enter production series in four ways: if farmers have naive expectations that next year's price will equal this year's price (the cobweb effect); if farmers have a target level of on-farm stocks; if other government policies are constant for a period of years, then change to a different mix for a few years, then change again; and if rainfall is autocorrelated. In this analysis it is assumed that the government's goals are well known to and believed by the populace. The government's desired price does not change from year to year, since the absence of trends implies that the equilibrium price in a normal weather year is constant. Given these assumptions, in the simple price band models the expected price is the same every year, regardless of the previous year's price. It is more difficult to characterize the rather complex policies that result from dynamic programming, although it can be said with certainty that the expected price will vary inversely with government stocks. The regression analysis of some of the optimal policies carried out in Chapter 6 indicates that a policy with a fairly large standard deviation of price ($12.10) produces an expected price 7.2 percent below normal when stocks are at their maximum and world price is at its minimum. The expected price is 6.4 percent above normal in the opposite situation. It should be understood that these are the extremes, and most years would be considerably closer to the mean. So if farmers are rational and the government is straightforward, the autocorrelation resulting from expectations will be negligible.

The second possible source would result if the farmers' target level of on-farm storage influences their production decisions. In this case, a bad year that depletes on-farm stocks would induce increased plantings in the subsequent year; similarly, a good year that increases stocks would lead to decreased area planted to maize in the next year. This, then, is an argument for negative autocorrelation, for which there is no empirical evidence. The autocorrelation parameter measured over the years 1970 to 1983 is + 0.12.[17] Although there may be some supply response to on-farm stock levels after exceptionally bad years, this positive (although insignificant) autocorrelation parameter indicates that the effect does not occur often enough to have a large average effect.

The third source of autocorrelation, fairly consistent government policies that change periodically, is assumed away in this analysis. Any attempt to measure trade-offs between government objectives must choose which possible instruments the government will use to affect the area under analysis and hold all other government policies constant. Agricultural credit policies, for example, have been left out and are assumed to be constant throughout the time horizon. Similar assumptions must be made when doing any analysis of this type.

The final possible source of autocorrelation, rainfall, is the subject of some debate in Kenya. Many persons in the country believe in rainfall cycles, with the most often heard number being 10 years. Although Kenya has reasonably good rainfall data, going back 30 or 40 years in some cases, these series are too short to check for cycles of this length. Although there is some evidence in the rainfall data for shorter periods of autocorrelation in single agroecological zones, Kenya's ecological diversity lessens the effect of any autocorrelation that might be present in individual zones.

Supply Response. Supply response to price occurs only when expectations about relative prices in one year differ from expectations about relative prices in another year. As explained above, expected prices will be constant for the price band policies and close to constant for the optimal policies. Long-term expected prices are the same in both cases. Therefore, the appropriate supply elasticity would be a short-term elasticity, which would be smaller than a long-term elasticity. The recent study by Booker International surveys other studies of supply response of maize production in Kenya, in which estimates range from 0.15 to 0.95. Their own estimating equations in conjunction with comparisons from other studies leads them to a best guess of around 0.40.[18] Even this number seems somewhat large for a staple food in a poor country. Timmer, Falcon, and Pearson (1983) point out that from comparative experience one would expect the supply elasticity for a basic cereal grain to be between 0.20 and 0.30. Nevertheless, if the short-term supply elasticity is taken to be the higher value of 0.40, even assuming a large deviation of expected price from normal of 7 percent, the maximum expected change in maize production is less than 3 percent. In most years it will be much smaller.

There are at least two possible nonprice factors that could induce a supply response. The first, unequal changes in expected yields for competing crops, is assumed to be unimportant. This is equivalent to assuming that trends in yields for competing crops are approximately equal to trends in maize yields. The second factor, a target for on-farm maize stocks, has been discussed above under autocorrelation.

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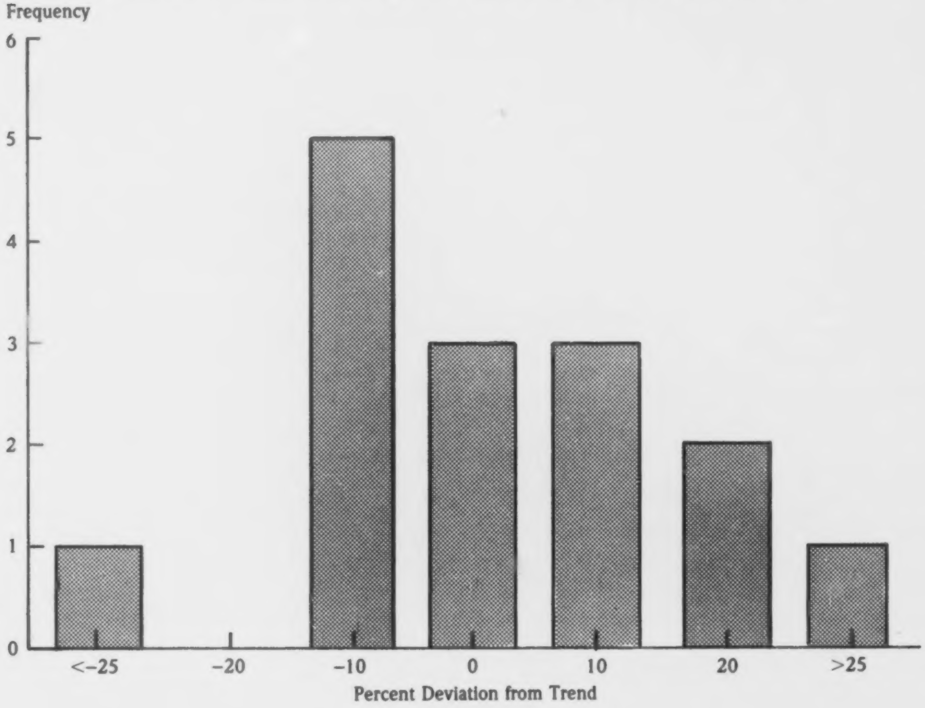
[17] As measured from 1970 to 1984 the parameter is + 0.39. This is considered inaccurate because the probability of a shortfall in production of the degree that occurred in 1984 is less likely than 1 in 15 (the implicit assumption of the regression analysis). See the discussion on the standard deviation of production below.

[18] Booker estimates supply response for different regions of the country. A weighted average of their different numbers is about 0.4. See Booker International 1983, Annex 5, Appendix 2, Table 1, and Annex 5, Appendix 4, Table 1.

Thus, nonprice supply response factors are unimportant, while supply response to changes in expected price could be as large as 3 percent in rare years for the optimal policies. Ignoring this price response will not lead to a large bias, since it is dwarfed by the standard deviation of production, which will be 10 percent (discussed below). The direction of the small bias will be toward overestimation of costs and stock requirements, since the expected price in the optimal policies will be higher in years of high world price and low stocks. Thus positive supply response will occur in exactly those situations when the country has the most to lose from a production shortfall.[19] Sensitivity analysis of the standard deviation of production will capture the effects of supply response to some extent.

Normality. Some analysts believe that production should not be considered to be normally distributed, arguing that since both exceptionally heavy rainfall and exceptionally poor rainfall lead to poor crops, production will be skewed downward. Indeed, U.S. aggregate production data for feedgrains tend to be skewed in this direction (Gustafson 1958). Data from Kenya, however, tend to show the opposite. Figure 3 shows a frequency diagram of percentage deviations from trend using data from 1970/71 to 1984/85. While the series is too short to warrant any conclusions, the apparent

Figure 3—Maize production frequency diagram, 1970/71-1984/85



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[19] However, rational expectations that include knowledge of other farmers' supply response will dampen this effect. See Gardner 1977 and Plato and Gordon 1983 for a discussion of solution techniques for the difficult problem of including supply response in a dynamic programming model.

skewness is to the right.[20] Leaving out 1984/85, the series is dramatically skewed upward. Some a priori reasoning supports upward skewness. A significant percentage of maize area in Kenya is planted in semiarid areas. In these areas, the standard deviation of production is often larger than the mean. Thus, production in these areas is never more than one standard deviation below the mean, while it may occasionally be two or three standard deviations above the mean. In about 10-20 percent of all years, production is almost nil. In effect, the bottom tail of the distribution is chopped off, leading to a distribution that is skewed upward. Positive skewness that decreases with application of nitrogen was also found by Day (1965) for maize in the Mississippi Delta. Thus there are a priori arguments for skewness in both directions, conflicting evidence from the United States to support skewness in either direction, and some evidence from Kenya to support skewness upward. Amid these mixed signals it is both prudent and convenient to depend on the Central Limit Theorem and assume a normal distribution.

Demand

As stated in the data section, demand is even more of a problem than production and therefore is modeled even more simply, as a nonstochastic, constant elasticity curve that depends only on the price of maize:

$$\ln(D_t) = C + e_m \cdot \ln(P_t), \tag{2}$$

where

$\ln(\cdot)$ = natural logarithm function,

D_t = demand for maize in year t,

C = constant,

e_m = own-price demand elasticity for maize (a negative number), and

P_t = price of maize in year t.

Such a specification is in line with Bigman's (1985) suggestion. As pointed out above, there is no trend in demand. In addition, demand is not stochastic. While it would be easy to make demand stochastic in the simulation models, the dynamic programming models would become more difficult to compute because of the aforementioned curse of dimensionality.

Stochastic demand is not, however, important relative to stochastic supply. The main source of stochastic demand would be fluctuations in real per capita income. The coefficient of variation of real GDP per capita from 1972 to 1985 (during which time GDP per capita shows no trend) is 3.3 percent. The average income elasticity for maize in Kenya used in the Booker study is + 0.60.[21] Thus the appropriate coefficient of variation of demand would be 2.0 percent, which is negligible compared with the importance of supply variations.

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[20] Measuring skewness in this way assumes that the trend line represents normal weather years. Clearly, this may not be the case.

[21] Calculated from Booker International 1983, Annex 5, p. 33, and Annex 5, Appendix 3, Table 3.

Maize, however, is an important income-producing crop for a large segment of the population, and fluctuations in maize production are included in the model. Thus it would be possible to include demand fluctuations that result from changes in income associated with maize production fluctuations. This factor, however, turns out to be negligible. The gross value of maize production accounts for approximately 5.0 percent of Kenya's GDP. With a coefficient of variation of production of 10.0 percent and income elasticity of 0.6, the coefficient of variation of demand resulting from this source is only 0.3 percent. It is consequently not worth including.[22]

After the nonstochastic nature of demand, the second point to note is that the demand curve is constant elasticity. A constant elasticity curve is more appropriate than a linear curve and less ad hoc than a kinked curve. A linear demand curve implies that as price increases, demand responds more flexibly to price. This is an unlikely occurrence for the most important source of calories in a poor country.

A third assumption is the absence of other prices in the model. As mentioned above, this analysis assumes that all other government policies are held constant, so to the extent that government controls prices, the terms should all be absorbed in the constant. There is, however, a problem in that weather affects production of all crops, not maize alone. FAO (1984) estimates that from 1979 to 1981, maize accounted for 40 percent of total calorie consumption. The next seven most important sources of calories are sugar (10 percent), wheat (6 percent), oils and fats (6 percent), cassava (6 percent), sorghum and millet (5 percent), pulses (5 percent), and potatoes and sweet potatoes (3 percent). Total calorie consumption from all seven of these alternative sources, however, is no greater than the calories consumed from maize alone. Prices of sugar, wheat, and oils and fats are effectively controlled by the government.

Although the remaining crops are grown to a large extent in different agroecological zones with different weather patterns, there are nevertheless significant correlations in the production of some of the different calorie sources. A shortfall of rain that leads to a poor maize crop will raise prices of maize and thus decrease consumption; however, if the low rainfall also diminishes the bean crop, the rise in the price of beans will increase demand for maize, thus dampening the own-price effect. Since bean calorie consumption is only about 12 percent of maize calorie consumption on average, the effect from beans alone will not be large. But in a year like 1984/85, when the maize, bean, and potato crops all failed, the cross-price effects may have been significant, leading to a smaller decrease in maize demand than would have been forecast by looking at maize prices alone. It is difficult to know the magnitude of these effects, however, due to the absence of any data on potatoes and beans and on how much maize was distributed as food aid.

Although this is a problem for a simple model of demand, there seems little alternative to the formulation above. Adding additional crops would increase the costs of the study significantly (primarily by complicating the dynamic programming analysis) while clouding the interpretation of results. If reasonably good time series data were available for other crops, these costs might be offset by the benefits of increased realism. But when the absence of data would require heroic assumptions about even the most basic facts, the costs of including the additional crops are higher than any potential benefits. Clearly, the situation would be quite different in a country with a more complete data base.

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[22] This factor could be important in a regional model for major maize-producing regions.

Trade and Stock Equation

The clearing equation used is as follows:

$$D_t = Q_t + M_t - X_t - (S_t - S_{t-1}), \tag{3}$$

where

D_t = demand for maize in year t,
Q_t = production in year t,
M_t = imports in year t,
X_t = exports in year t, and
S_t = government stocks in year t.

Since the government controls imports, exports, and stocks, this can be simplified by defining a variable NP to be government net purchases (NP_t):

$$NP_t = -M_t + X_t + (S_t - S_{t-1}). \tag{4}$$

Substituting equation (4) into equation (3) yields

$$D_t = Q_t - NP_t. \tag{5}$$

There is some debate in Kenya about the importance of private stocks, which are not included here. While there is no question that such stocks are large during certain seasons of the year, some observers believe that the levels change little from one year to the next because real official prices are fairly constant. The only evidence available, mentioned above, shows stocks of small holdings changing by 73,000 tons in one year.

There are two distinct reasons for holding private stocks in Kenya: security and speculation. It is likely that small farm households have a desired level of carry-out stocks for family security that is not particularly price sensitive. After poor harvests these stores are depleted, and then are replenished after the next good crop. Casual observation in different parts of rural Kenya confirms this belief, and the maize disappearance (consumption) figures in Table 6 are consistent with it.

The amount of grain stored from year to year for speculative purposes in Kenya probably has been small. This is to be distinguished from seasonal speculation on local markets and short-term speculation on changes in official government prices. Annual price speculation has rarely been profitable in the urban areas, where the NCPB has been relatively successful in holding real prices constant. In rural areas, it is more difficult to arbitrage large quantities across years, particularly since the practice is illegal. While illegality is obviously not a complete deterrent, the cost of the activity is high because of the need for bribes and secrecy.

Unfortunately, other than the two data points from Integrated Rural Survey 3, there are no time series data whatsoever on private stocks in Kenya, and nothing but hearsay and anecdotal evidence to go on. For this type of analysis, the private stock buildup and run-downs will correspond to some extent with similar activity in government stocks. Thus, leaving out this type of security, private stocks may overestimate the level of government stocks necessary to gain a certain level of price stability. As for speculation, some of the policies modeled below would lead to significantly greater changes in price from year to year than Kenya has experienced officially in the past. But if the private market's storage charges and discount rate are greater than or equal to the figures used here for the government—approximately $25 per ton and 7 percent—full storage costs would never be covered for any of the policies modeled. So it is unlikely that the increase in speculation would be large.[23]

For the simulation, it is necessary to relate price to the exogenous variable, production, and the government decision variables. This can be done by substituting equation (5) for D_t in equation (2):

$$\ln(Q_t - NP_t) = C + e_m \cdot \ln(P_t), \tag{6}$$

and solving for the logarithm of price:

$$\ln(P_t) = [\ln(Q_t - NP_t) - C]/e_m. \tag{7}$$

World Price Equation

The world price is modeled as a percentage random walk in the simulation models. This is equivalent to a random walk in logarithms. It is desirable for the optimization model to model world price so that the expected value of world price next year equals this year's world price. Some studies, such as the one by Knapp (1982), assume that world price behaves as a random variable with known mean and variance. If this is done, the expected value in the following year at times will be much higher or lower than the present price. The optimizing algorithm will then "borrow foreign exchange, increase imports, and put the additional grain in storage" (Knapp 1982, 201-202). This builds world price speculation into the model. But, surely, increasing imports of maize is an inappropriate way for a normally self-sufficient country like Kenya to speculate. If the government of Kenya knows that the world price behaves as a random variable with a particular mean and variance and knows that the present price is low, it should enter the futures market, not import more maize. In addition, if enough actors have this knowledge about world price, a large number of them will enter the futures market, and world price will no longer behave as a random variable with known mean and variance. So this assumption is inconsistent with the existence of futures markets. Modeling world price as a random walk, on the other hand, makes the expected value of the world price equal to the present price, so that there is never an incentive to speculate.

Three variants of the Dickey-Fuller test were run to see if the series of the logarithms of real maize prices from 1957 to 1986 behaves as a random walk with [illegible] root.[24] In the three model specifications below, the coefficient "B" is tested by [illegible] different parameters for difference from 1:

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[23] Peck (1977/78) has shown that private storage in the United States increases with increasing changes in expected price, even though the difference is less than full carrying costs. If such a relation exists in Kenya, it will lessen the need for the government to hold stocks.

[24] The time series used is for U.S. gulf port no. 2 yellow maize prices, deflated by the U.S. wholesale price index. The tests are described in Dickey and Fuller (1979), using significance tables found in Fuller (1976). Simple t-statistics for the lagged variable are not appropriate tests. The article shows that the Dickey-Fuller test is more powerful than the Q-statistic (Portmanteau test) described in Harvey (1981, 48).

$$WP_t = BWP_{t-1} + e_t,$$
$$WP_t = A + BWP_{t-1} + e_t, \text{ and}$$
$$WP_t = A + BWP_{t-1} + Ct + e_t,$$

where

WP_t = world price in year t,
A, B, and C = estimated parameters,
t = time, and
e_t = error term.

All six tests are insignificant at the 10 percent level.

The third specification is of interest because time is included in the model. The estimated equation is as follows:

$$\begin{aligned} WP_t &= 0.378 + \underset{(0.16)}{0.76WP_{t-1}} - \underset{(0.0033)}{0.0049t}; \\ R^2 &= 0.59, \end{aligned} \tag{8}$$

where the numbers in parentheses are standard errors. The negative trend is significant at the 10 percent level. The estimated trend is for world prices to decline by 0.5 percent per year. Nevertheless, a negative trend is not included in this model for three reasons. First, it is desirable for the optimization model to have the same structure in each of the model years so that a stable policy will be found. Including a negative trend would make this impossible. This added complication would not be a factor if the trend was certain to continue in the future and if it would imply quite different policies. This, however, is not the case. In mid-1987 it is not at all clear that world maize prices will continue their downward trend; in addition, the size of the historical trend is such that the effect of including it in the model would be small.

Thus, for the simulation, world price behaves as follows:

$$WP_t = WP_{t-1} \cdot (1 + u), \tag{9}$$

that is, the world price in year t equals the world price in the previous year times 1 plus a random variable u, which is distributed normally with 0 mean and a standard deviation of WSD. The number WSD is an estimate of the average percent change in world price from one year to the next.

In the discrete world of the dynamic programming models, it is impossible to allow the world price to behave as a random walk without including an unacceptably large number of possible world prices. With a smaller number of levels, either the expected price will not always equal the present price or, at the extreme price levels, there will be no possibility of a change in prices. To take a simple example, suppose that the model allows only three possible price levels: $90, $120, and $150 per ton. If the price is $120 in one year, it is easy to make the expected price in the next year also equal to $120 by assigning equal probabilities to $90 and $150. But if the price is presently $150, there is no higher price to which it can climb, so either the probability of the price dropping to $120 or $90 must be zero, or the expected price in the next year must be less than $150.

The dynamic programming models use seven levels of world price and choose the latter option. Table 7 lists the expected price at each level of world price. The differences are rather small except at the extremes, where they are about US$7 per ton. The discrete levels of world price also make a percentage random walk difficult to implement, so the optimizing model approximates a normal random walk.

Government Objective Function

As presented in Chapter 2, the three government objectives included in the dynamic programming models are stabilizing prices around a normal-weather-year price, minimizing imports, and minimizing government expenditures. This objective function affects only the solution algorithm of the optimizing model. For the simulation models, the value of the objective function does not affect the decision variables, since the simulation models do not maximize or minimize an objective function. The average value of each of the three components of the objective function, however, is still computed for comparison with the optimal values.

In equation form, the goals can be stated as follows:

$$\text{Minimize:}\quad GC = \Sigma\,[COST_t + a(P_t - P^*)^2 + bM_t]/(1 + r)^{t-1}, \tag{10}$$

that is, minimize GC, which equals the sum over all years of the government's fiscal cost, plus a parameter "a" times the square of the deviation of the present year's price from the target price $(P_t - P^*)^2$, plus a parameter "b" times imports (M_t), the quantity being discounted for time preference at discount rates. The parameters are weights that measure the importance of each of the objectives relative to the other two. These weights, which were referred to in Chapter 3, are varied in order to find policies that efficiently produce more of one objective and less of the other two. This allows for the measurement of trade-offs.[25] By not putting a weight on COST, the monetary unit becomes the numeraire of the system.

The nature of the objective function will be addressed by discussing, first, the price component and discounting; second, the components of government cost; and finally, other possible objective functions.

Table 7—Expected values of world price in dynamic programming models

Price in Year t	Probability of Price in Year t + 1							Expected Price
	$60	$80	$100	$120	$140	$160	$180	
(US$/metric ton)								(US$/metric ton)
60	0.725	0.239	0.035	0.001	...	...	...	66.24
80	0.239	0.486	0.239	0.035	0.001	...	...	81.46
100	0.035	0.239	0.451	0.239	0.035	0.001	...	100.06
120	0.001	0.035	0.239	0.450	0.239	0.035	0.001	120.00
140	...	0.001	0.035	0.239	0.451	0.239	0.035	139.94
160	...	...	0.001	0.035	0.239	0.486	0.239	158.54
180	...	...	...	0.001	0.035	0.239	0.725	173.76

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[25] In a linear programming environment, an equivalent formulation would be to include two of the three objectives as constraints, and vary the right-hand side in order to trace out trade-offs between objectives (see Eaton 1980). In dynamic programming, this is not a feasible alternative, and the different objectives must be included and weighted in the objective function.

Deviations of price from the goal enter as a squared term (Blandford and Lee 1979). In a country like Kenya, where prices have been controlled for so long, penalizing the absolute value of the deviation would not be correct; a 50 percent increase in price is much more than five times worse than a 10 percent increase. The penalty should be symmetric, since farmers make up such a large percentage of the population. The simplest functional form that satisfies these two criteria is the one that is used.

All three terms are discounted in future years. Clearly, a government would trade a 10 percent increase in price this year for a 10 percent increase in price five years in the future were such a deal possible, at least in part because the official making the decision might leave the government before then.

The COST term has three annual components and a fourth cyclic component. These are within-country operations, foreign trade costs, storage costs, and stock replacement costs. They will be described in turn.

Within-Country Operations. Net proceeds of within-country sales are $P_t \cdot NP_t$, where NP_t is government net purchases (so that NP_t is negative when the government sells maize).

Foreign Trade Costs. Foreign trade costs and benefits are difficult to compute in Kenya. Import parity prices usually are computed by adding local and foreign shipping costs to the world price, while export parity prices subtract local costs. The situation in Kenya is somewhat more complex for two reasons: first, in any one year, relatively small quantities of maize can be exported at a white maize premium, and second, food aid is available. An optimal maize policy should take advantage of both of these facts, so they must be built into the model.

Export premiums are available because white maize is usually a preferred commodity on the world market. The market is thin, however, and most countries that want to import white maize are short of foreign exchange. In 1983 and 1984, Kenya was able to make arrangements for the World Food Programme (WFP) to buy about 100,000 tons of Kenyan maize and ship it to third countries, mainly Somalia. The WFP saved money on transport and passed all those savings, plus a white maize premium, on to Kenya. The total premium for Kenya was about $50 per ton. Such deals are somewhat difficult to negotiate and probably could not be arranged for large quantities of maize. To some extent, these arrangements are more like WFP aid for Kenya rather than business deals; therefore, if Kenya were to export 300,000-400,000 tons of maize in one year, it might be reasonable to expect the WFP to buy the first 100,000 tons at a high price even if considerable amounts of additional maize were being exported with no premium. So in the model, Kenya exports its first 80,000 tons in any one year at a price that is $40 above the prevailing world price, with the premium decreasing linearly and disappearing for exports other than the first 120,000 tons. Thus the gains from exports are as follows:

$$\text{If } X_t \leq 80{,}000, \text{ then} \qquad (11)$$

$$XP_t = X_t \cdot (WP_t + 40 - XCOST).$$

$$\text{If } 80{,}000 < X_t < 120{,}000 \text{ then}$$

$$XP_t = X_t \cdot (WP_t - XCOST) + [3200 + (160 - X_t)/2 \cdot (X_t - 80)].$$

$$\text{If } X_t \geq 120{,}000 \text{ then}$$

$$XP_t = X_t \cdot (WP_t - XCOST) + 4000,$$

where

XP_t = export proceeds in year t,
X_t = exports in year t,
WP_t = world price in year t, and
$XCOST$ = cost of exporting.

On the import side, food aid complicates the picture in two ways. First, it is clear from 1979/80 and 1984/85 that Kenya can arrange for food aid in crisis years. While the amounts received in those years may have been larger than they would have been in a tighter world maize market, there is no doubt that the United States and other donor countries will support Kenya to a significant extent in times of trouble. But food aid will not be available in years of minor shortfalls, and in serious drought years the first batch of imports would have to be ordered commercially in order to receive the maize quickly. A second problem is that a considerable proportion of food aid is not available for the government to sell. Since this study deals only with marketed and own-produced maize, not with relief, aid that is freely distributed should not be included in the models. (To the extent that free food aid substitutes for food that would be purchased in the market, it should be included in total supply.) Finally, although it is difficult to predict the response of donors to a shortfall in production, they are likely to base aid decisions on estimates of total supply (production plus government stocks, since private stock figures are unavailable) rather than production alone or planned government imports. There is no obvious model to use here, but past actions indicate that donors will make up about 40 percent of the difference between total supply and a figure that is 100,000 tons below normal-year production. For instance, if normal-year production is 2.0 million tons, government stocks are 50,000 tons, and production is 1.8 million tons, donors would be expected to provide 20,000 tons in food aid to the marketing board. Since Kenya has to pay transport costs on food aid, the accounting is as follows:

$$\text{If } Q_t + S_{t-1} > Q_0 - 100{,}000, \text{ then} \qquad (12)$$

$$AID_t = 0.$$

Otherwise,

$$AID_t = 0.4 \cdot [Q_0 - 100{,}000 - (Q_t + S_{t-1})], \text{ and}$$

$$MC_t = M_t \cdot (WP_t + MCOST) - AID_t \cdot WP_t,$$

where

Q_t = production in year t,
S_t = opening sales in year t,
Q_0 = normal-year production,
AID_t = food aid in tons in year t.
MC_t = total cost of all imports in year t,
M_t = commercial imports and aid in year t,
WP_t = world price of maize in year t,
$MCOST$ = cost of importing, and

DT = domestic component of import costs minus the cost of handling domestically purchased maize.

These models of food aid and export premiums are admittedly ad hoc. Given a situation in which both food aid and export premiums have significant effects on Kenya's maize strategy, however, it would be clearly wrong to leave them out of the model.[26] The only solution is to make the kind of reasoned judgments used here and include these components in the model.

Storage Costs. Storage charges include losses, railage to and from the stores, and any costs associated with turning over the stocks to keep them fresh. These costs are considered to be constant per unit of stock. As the maximum stock level chosen by the optimizing program is less than the presently available storage in Kenya, there is no need for increasing marginal costs of storage to reflect increasing costs of the space.

$$SC_t = S_t \cdot STCOST, \tag{13}$$

where

SC_t = total storage cost in year t,
S_t = closing stocks in year t, and
STCOST = cost per ton of holding stocks.

Note that the storage facilities themselves are neither costed nor amortized. This is for two reasons: storage is already in place, has virtually no rental value, and is not considered a cost in the country; and donor funds probably would be made available for construction of storage if more were desired.

Interest charges are not included in the costs of storage. This causes some problem in explaining the model to policymakers, who see large interest costs in the financial report of the NCPB each year. But as Gardner (1979, 18) points out, it would be incorrect to include such costs. This is best seen by considering a risk-neutral private trader, who will store grain until his expected costs equal his expected benefits. That is, until

$$P_{t+1} = (P_t + STCOST)(1 + r), \tag{14}$$

which is equivalent to

$$P_{t+1}/(1 + r) = P_t + STCOST,$$

where STCOST is storage cost and r is the interest rate. If the interest rate equals the time value of money, the discounted objective function used in the model will consider two policies to be of equal cost in exactly these circumstances. An objective function that charged interest on stocks and also discounted future benefits would include a second (1 + r) term in the denominator on the left-hand side, incorrectly adding another cost to the storage operation.

If the market interest rate differs from the perceived time value of money—which it may, since there could be constraints on Kenya's ability to borrow foreign exchange—then those policies that increase borrowing should add the differential interest charges to the other costs, and those policies that decrease borrowing should subtract the same. In this model, that would mean adding an interest charge to imports and subtracting interest charges from exports. This has not been done here, although such adjustments could easily be added to the model. Note that even if these charges were included, there would not be a direct interest charge on maize in storage, but policies that resulted in more exports (and thus lower levels of storage) would cost less.

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[26] A similar model for wheat in Pakistan has been run with no export premiums. The optimal net purchases function has the same shape and the same sensitivity to parameters. The only significant difference is the shape of the closing stock curve; in the Pakistan case no exports take place until the maximum stock level is reached.

Stock Replacement Costs. Charges for replacement of stock are included in the simulation models to facilitate the comparison of policies that end with different amounts in store. All models begin with 100,000 tons in year 0. The models end each cycle with anywhere from zero to 250,000 tons in store on average, with individual cycles varying more widely. Unless some allowance is made for these changes in stock level, the policies that end with low levels will appear to be more profitable, since they include the proceeds of selling the stock. There are two alternatives: (1) value the excess or deficit stock at a constant price and add the charge to the total for that policy, or (2) force the models to export or import in the final year in order to end up with exactly 100,000 tons. The latter option penalizes the optimal policies more than the price band policies, since the optimal policies on average hold more stock in years of low world prices. Since the price band policies will be compared with the optimal policies in chapters 3 and 4, option 1 is used here. The value chosen is the base year world price (which is equal to the average world price across all simulations because of the nature of the stochastic process).

$$RS = (S_0 - S_{10}) \cdot WP_0, \tag{15}$$

where

RS = replacement stock charges,
S_0 = closing stocks in base year,
S_{10} = closing stocks in year 10, and
WP_0 = world price in base year.

Note that the optimizing algorithm does not consider this charge in its choice of the optimal policy. Since the desired optimal policy is one that ignores the terminal conditions in the model, including these charges would not affect the stabilized policy.

Other Types of Objective Functions

Most optimizing studies of stabilization policy have not used a multiple-attribute, weighted utility function as the objective function but have used consumer/producer surplus, considering it a proxy for national welfare. As Gustafson (1958, 48-49) has shown, the result of using consumer/producer surplus is the free market solution, provided the private discount rate and storage costs equal those of the government. A model with this objective function is used as a reference. It is inappropriate for the bulk of the analysis, however, for the following reasons.

First, one supposed advantage of using consumer/producer surplus is that benefits and losses of various policies can be ascribed to different groups in the economy. Indeed, a substantial amount of the price stabilization literature deals with this issue. But as Sarris and Taylor (1978, 149-159) have shown, the shape of the demand curve is of central importance in determining such gains and losses. Given the paucity of information about demand in Kenya, it would be at best pointless and at worst misleading to measure triangles around a curve of unknown shape.

A second objection is pointed out by Cochrane (1980). For a staple food in a poor country, income effects of price changes will be large but totally ignored by the welfare measure. In addition, consumer surplus from resulting price changes in other commodities could be large but unmeasured.

Finally, regardless of whether or not such an objective function is appropriate in other contexts, it is inappropriate here because the purpose of this study is to affect government policy by measuring trade-offs between government objectives. The Kenyan government *wants* to stabilize prices; in fact, ever since independence (and before) the government has claimed to control prices directly. In such a situation, it is important to try to discover how much this sort of total price stability costs the government *in terms of its own objectives,* and how much of its other objectives it can "buy" by "selling" some price stability. For this study to be effective, the objective function of the analysis must be one relevant to the government that allows for the measurement of trade-offs, and not "an illusion created by an alternate purchasing power procedure which is non-operational" (Cochrane 1980, 508). A multiple-attribute, weighted utility function is the appropriate tool for measuring trade-offs, since the weights on the parameters can be varied directly to come up with points in the noninferior set (Blandford and Lee 1979).

A different approach would be to transform the government objective function used here into a utility function that would include a risk-aversion coefficient, as Buccola and Sukume (1987) have done for Zimbabwe.[27] Alternatively, the utility function of a government official can be measured directly, as Parton (1979) has done for wool in Australia. The latter is an interesting approach and might be particularly useful for deciding on the form of the function. But given the complex nature of the decisionmaking process for changing public policy, it is unclear whose utility function should be measured (Cohon and Marks 1975, 213). In addition, given the political sensitivity of the issue, it seems likely that the responses to counterfactual questions could be quite different from the decisionmaker's actual response in a crisis.

In sum, the objective function used here, like the rest of the model, is a simple tool formulated to address the specific substantive issue at hand, which allows for the measurement of trade-offs between three important government objectives with adjustments in a minimum number of parameters.

Price Band Decision Rules

This completes the description of the model for the dynamic programming runs. Government reponse to any particular production outcome is not specified ahead of time, but results from the maximization of the objective function. The policy rules, therefore, are endogenous. For the price band simulations, it is necessary to specify government policy toward different levels of production, stocks, and world prices. So a simple set of administrative rules is added to the previously defined market structure, as outlined in Chapter 2. The government chooses a price P^* as its target, which is the normal production year equilibrium price with no government intervention:

$$\ln(P^*) = [\ln(Q_0) - C]/e_m, \qquad (16)$$

where Q_0 is normal-weather-year production, C is the constant in the demand equation, and e_m is maize demand elasticity. The government then chooses a range in which to allow prices to vary without government intervention. The maximum percent price variation, W, is both added and subtracted from ln(P*) to produce the maximum and minimum allowed price:

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[27] It is debatable, however, whether or not governments should be considered risk averse. See Valdés and Siamwalla 1988, especially p. 118.

$$\ln(P_{max}) = [\ln(Q_0) - C]/e_m + W, \text{ and} \tag{17}$$

$$\ln(P_{min}) = [\ln(Q_0) - C]/e_m - W. \tag{18}$$

Substituting equation (7) into equation (17) for $\ln(P_{max})$,

$$[\ln(Q_{min} - NP_t) - C\,]/e_m = [\ln(Q_0) - C]/e_m + W, \tag{19}$$

where Q_{min} is the production level that corresponds to the maximum price, P_{max}, and NP_t is net government purchases. Since all government decision variables are zero within these limits by definition, NP_t can be set to zero. Making that substitution and solving for Q_{min} yields

$$Q_{min} = EXP[\ln(Q_0) + e_m \cdot W], \tag{20}$$

where EXP is the exponential function. Since e_m is a negative number, Q_{min} is less than Q_0 if W is greater than zero.

A similar derivation yields the figure Q_{max}:

$$Q_{max} = EXP[\ \ln(Q_0) - e_m \cdot W]. \tag{21}$$

So if production is between Q_{max} and Q_{min}, the government does not intervene; if production is outside those limits, the government buys or sells maize:

$$\begin{gathered} \text{If } Q_t > Q_{max}, \text{ then} \\ NP_t = Q_t - Q_{max}. \\ \text{If } Q_t < Q_{min}, \text{ then} \\ NP_t = Q_t - Q_{min}. \\ \text{If } Q_{min} \leq Q_t \leq Q_{max}, \text{ then} \\ NP_t = 0. \end{gathered} \tag{22}$$

Exports and imports are determined by the opening stock level, net purchases, and the level of stock variability, S_{max}. For computational purposes, the minimum stock level will be considered to be zero, but as pointed out in the previous chapter, in the actual case a minimum stock level equal to two or three months maximum net sales should trigger imports, since there is a delay between ordering and receiving foreign maize (a positive minimum stock level would have to be specified in a model that includes seasons).

$$\text{If } S_{t-1} + NP_t > S_{max}, \text{ then} \tag{23}$$

$$X_t = S_{t-1} + NP_t - S_{max}, \text{ and}$$

$$S_t = S_{max}.$$

Otherwise,

$$X_t = 0, \text{ and}$$

$$S_t = S_{t-1} + NP_t,$$

where

S_{t-1} = opening stocks in year t,
NP_t = government net purchases in year t,
X_t = exports in year t, and
S_t = government stocks in year t.

$$\text{If } S_{t-1} + NP_t < 0, \text{ then} \tag{24}$$

$$M_t = -(S_{t-1} + NP_t), \text{ and}$$

$$S_t = 0.$$

Otherwise,

$$M_t = 0, \text{ and}$$

$$S_t = S_{t-1} + NP_t,$$

where M_t is imports in year t.

At this point, the model has been developed and the price band administrative rules defined explicitly. Appendix 2 includes outlines of the computer programs used for the simulation and optimization processes. In the next section, the price band simulations are compared and contrasted with the optimizing process.

Comparison of Price Band Simulation with Optimizing Algorithm

In order to take full advantage of the four reasons for conducting an optimization outlined in Chapter 3, it is necessary that the computation of the three components of the objective function for the optimal policies and the price band schemes be directly comparable. After running the price band simulation and the dynamic programming optimization, the results are not comparable because of several differences between the two models. These differences are enumerated in Table 8.

As indicated in Chapter 3, the differences between the models are reconciled by taking the dynamic programming solution and simulating it in the same way that the administrative rules are simulated. This requires that the following adjustments be made for the differences noted in Table 8 (numbers 1-7 below correspond to the numbers in the table).

1. As shown in the example in Chapter 3, the result of running a dynamic programming algorithm is a set of tables listing each possible state of the world and the optimal values of the control variables for each state in each year. Thus, for each possible combination of domestic production, world price, and opening stocks, the appropriate net domestic purchases and net foreign trade are listed. These optimal policies may vary in each year of the optimization run. Fortunately, models such as this one in which the system parameters do not vary from year to year will usually stabilize after

Table 8—Differences between price band simulation and dynamic programming models

Price Band Simulation	Dynamic Programming
1. Policy is identical in each year.	Terminal conditions affect policy in last several years.
2. State and control variables are "continuous."	State and control variables are discrete.
3. World price is modeled as a percent random walk.	World price approximates a normal random walk.
4. Ten-year cycles are run.	Program runs for an eight-year cycle, or until the policy stabilizes.
5. Replacement-of-stock charges are included.	Replacement-of-stock charges are not included.
6. Policy is determined by an administrative rule.	Policy is determined by minimization of present and expected future value of a cost function.
7. Feasible combinations of objectives are found by changing allowed price deviation and stock variability.	Feasible combinations of objectives are found by varying weights in the cost function.

several years, and these stabilized values ignore the terminal conditions. The model used here usually stabilizes after five or six years. The stabilized values are used in the simulation, so the optimal policy is constant across years.

2. The discrete values of the dynamic programming solution are linearly interpolated in order to approximate a continuous optimal policy.

3. The simulations of the optimal policy treat the world price as a percent random walk just as in the price band simulations. This leads to some slight suboptimality of the simulated policies, since the conditions under which optimization took place are different from the conditions of the simulation.

4. Ten-year cycles are used in the simulation of the optimal policies just as in the simulation of the price band schemes. Since the chosen optimal policy is a stabilized policy, and since the object is to test the stabilized policy rather than to reach certain terminal conditions, this is the appropriate method to use. There is no loss of optimality.

5. The addition of replacement of stock charges does not affect optimality for the same reason as given in number 4. The purpose is to test a stabilized policy; the replacement of stock adjustment is used to allow for comparison between policies that consistently end with different stock levels. If such charges had been included in the optimization process itself, the final few years of the optimization would change, but the stabilized policy would be no different.

There is no need to reconcile the last two differences between the models. Indeed, numbers 6 and 7 lead to the first two benefits of optimization: screening all possible policy alternatives and accurately measuring trade-offs between government objectives. These last two are the essential differences between using an optimizing algorithm to select the policy and choosing an ad hoc rule. It is because of the differences that the optimizing process can help the analyst learn how to adjust the administrative rules to be more efficient.

The next and final section in this chapter selects the parameter values that are used in the model.

Parameters for the Model

The key parameters in the model are as follows:

- Cost of importing: $40 per ton, of which $35 is foreign exchange.
- Cost of exporting: $70 per ton, all local costs.
- Shadow price premium on foreign exchange: 15 percent.
- Maximum stock level: 580,000 tons.
- Discount rate: 7 percent.
- Opening world price: $120 per ton.
- Standard deviation of the world price: 14 percent.
- Standard deviation of production in Kenya: 10 percent.
- Own-price demand elasticity of maize: −0.3.
- Normal production year equilibrium price: $140 per ton.
- Cost of storage: $25 per ton.

Costs of Importing and Exporting

The official estimate of the costs to the NCPB of preparing maize for export was $80 per ton as of 1985.[28] Schluter (1984) gives a detailed breakdown of these costs as of 1981/82. Table 9 lists the costs as of that date, projects them to the 1985 total, and then makes two reasonable adjustments. First, the type of change in marketing policy envisaged by this study would decrease the purchase and transport charges incurred by the NCPB. It is assumed rather conservatively that this decrease would be 20 percent. Second, one large component of the export cost is the charge for bags. There are three ways these costs could be lessened: constructing bulk handling facilities both up-country and at the port, making use of some second-hand bags rather than all new bags, and using sisal bags rather than the present sisal/jute combination. Assuming that some combination of these measures is taken, the bag component of cost is decreased, first by the 10 percent duty on jute that Schluter includes, and then cut in half, for an overall decrease of 55 percent of the original estimate. The end result is a cost of exporting maize of about $70 per ton.

Table 9—Costs of exporting maize

Component	Schluter's Costs 1981/82	DPD/MOA 1985 Total	Assumed Savings	Final Estimate
	(US$/metric ton)		(percent)	(US$/metric ton)
Primary marketing	17.0	19.3	20	15.5
Bags	10.1	11.4	55	5.1
Drying	10.5	11.9	0	11.9
Railage	28.6	32.4	0	32.4
Wharf charges	1.7	1.9	0	1.9
Insurance	1.2	1.4	0	1.4
Interest	1.4	1.6	0	1.6
Total	70.6	80.0		69.8

Source: Based on data from Michael Schluter, *Constraints on Kenya's Food and Beverage Exports*, Research Report 44 (Washington, D.C.: International Food Policy Research Institute, 1984).

Notes: DPD/MOA is Development Planning Division/Ministry of Agriculture. Parts may not add to totals because of rounding.

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[28] Richard Goldman, personal communication, June 1985.

The costs for importing are similar to the costs for exporting. Throughout this study, the difference between the domestic selling and buying price of the NCPB is assumed to cover the board's costs. Imported maize is sold at the domestic selling price, which is the producer price plus the margin. The correct import parity price is thus the foreign transport cost—estimated at $35 per ton[29]—plus the difference between the domestic marketing margin and the costs of handling imported maize. The difference is about $5 per ton, and would not be affected by the adjustments made in Table 9, since those adjustments would affect both local and imported maize.

Shadow Price of Foreign Exchange

It is widely perceived that the Kenya shilling is officially aligned close to its shadow rate, with the demand for foreign exchange somewhat higher than supply at official rates. A figure of 15 percent overvaluation is a reasonably good estimate. It is consistent with black market rates (Cowitt 1985).

Maximum Stock Level

In the price band models, the maximum stock level is part of the policy and never reaches levels where Kenya's present storage capacity would be exceeded. In the optimizing models, however, a maximum stock level has to be chosen, since all the variables are discrete. In the early stages of formulating the model some tests were done, and a stock level of 580,000 tons was selected, since the model did not choose to store more than 560,000 tons under any of the circumstances reported in this study.

Discount Rate

A value of 7 percent was chosen as the discount rate. This is high when compared with real interest rates, but low compared with studies that attempt to elicit discount rates from individuals. For example, Clark, Jones, and Holling (1979) did not find a single decisionmaker with a discount rate of less than 10 percent in their attempts to elicit such values in Canada.

Opening Value and Standard Deviation of the World Price

The opening value of the world price is $120 per ton, close to the average world price for 1981-85. Choosing an appropriate value for the variability of world price is somewhat more complicated.

Recall that the world price is modeled as a random walk. The series of annual percentage changes in the International Monetary Fund series of U.S. gulf port yellow no. 2 maize prices from 1957 to 1986, deflated by the U.S. wholesale price index, has a standard deviation of 13.7 percent. There are two problems, however. First, variability has been increasing over time. The standard deviation of the series up to 1969 is only 7.3 percent, while the figure since that date is 16.1 percent. This consideration argues for a value higher than the average. The post-1970 figure of 16.1, however, is influenced heavily by the extremely large price increase of 43.0 percent in 1973. The 1973 value is almost twice as large as the next largest price change, and is almost 3.5 standard deviations from the mean. The standard deviation of the price changes from 1970 to 1986, excluding 1973, is only 12.5 percent.

This analysis uses a standard deviation of world price of 14.0 percent. It is inappropriate to give full weight to 1973, since it is such an aberration, but some consideration should be given to the recent increase in variability. The data clearly indicate that the best figure is between 12 and 16 percent. Fortunately, results of the model are not sensitive to changes in this parameter within that range. Early model runs with constant rather than variable world prices produced optimal policies quite close to those produced with variable world prices. The standard deviation of the fiscal cost is the only result that varies significantly with this parameter.

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[29] Richard Goldman, personal communication, June 1985.

For the dynamic programming models, as described above, the world price does not behave in a random walk. The seven possible levels of world price are taken to be $60, $80, $100, $120, $140, $160, and $180 per ton, with the transition probabilities chosen so that the expected values of next year's price are as shown in Table 7. These probabilities correspond roughly with a percentage change standard deviation of 14 percent at the base year world price of $120 per ton.

Standard Deviation of Production

The standard deviation used in the analysis should be a totally random phenomenon, neither the result of systematic factors in the world nor the result of changing government policies. This makes it difficult to come to an estimate of the number from past history. Since changes in government policy have exacerbated production fluctuations at times, the desired number will be less than the estimate of historical variation.[30] The difficulty is compounded by the large differences that result from including or not including the estimate of the 1984/85 crop in the analysis.

Running a linear trend through the maize production figures from 1970/71 to 1983/84 yields a standard error of the estimate of 225,000 tons. At mean production for the time period, this yields a standard deviation of 13.0 percent. On the other hand, if 1984/85 is included, the standard error increases to 306 and the mean is somewhat lower, giving a standard deviation of 17.9 percent.

Some degree of insight into the variability of maize production in Kenya can be gained by examining rainfall data in Kitale district. Kitale is a major exporter of maize to other regions of Kenya and normally has reliable rainfall. Production in 1984/85, however, was only about 50 percent of production the previous year; this shortfall was a significant percentage of the total shortfall of Kenyan production below trend for the year. Since a fairly consistent series of rainfall statistics is available for about twice as many years as the production series used in this study, the rainfall statistics can provide some additional insights into the degree of the rainfall abnormality Kenya experienced in 1984/85.

Table 10 lists rainfall data from Kitale for 1953-84 for the months of April and May, excluding 1956 for which no data are available. April and May are key months for Kitale maize production, as planting cannot be delayed much longer than early April. For 1965-84, the series is the average rainfall at all of the meteorological stations in the district. Data from the Kitale Agricultural Research Station are used for earlier years, as the average series is not available. None of the conclusions reached below are altered significantly by restricting the analysis to 1965-84 data.

Note three points about the series before considering the statistics. First, cumulative rainfall for March and April in 1984 is the lowest on record. While only slightly lower than the figure for 1958, it is almost 20 percent lower than the third lowest figure. In addition, the second, third, and fourth lowest figures are for 1958, 1955, and 1959,

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[30] For example, most analysts believe that the government was at least partially responsible for the production shortfall in 1979/80 (Kleist, 1985).

Table 10—Kitale rainfall: April and May, 1953-84

Year	Rainfall		
	April	May	April and May[a]
		(millimeters)	
1953	222	172	393
1954	125	160	285
1955	157	88	244
1956	n.a.	n.a.	n.a.
1957	149	137	287
1958	104	97	201
1959	127	125	251
1960	124	182	306
1961	166	145	310
1962	163	142	305
1963	163	144	308
1964	174	148	321
1965	126	133	258
1966	280	80	359
1967	224	260	484
1968	201	95	295
1969	54	229	283
1970	144	136	281
1971	148	118	266
1972	115	168	283
1973	45	210	255
1974	108	147	255
1975	104	210	314
1976	162	246	408
1977	257	153	410
1978	183	160	343
1979	191	165	355
1980	130	244	374
1981	210	152	362
1982	335	270	605
1983	101	326	426
1984	100	97	197
		Series Statistics	
Mean (millimeters)	158	166	323
Median (millimeters)	149	152	306
Minimum (millimeters)	45	80	197
Maximum (millimeters)	335	326	605
Standard deviation	62	59	84
Coefficient of skewness	0.79	0.84	1.33

Source: Unpublished data from the Meteorological Department, Kenya.
Note: n.a. means not available.
[a] Parts may not add to totals because of rounding.

respectively. The figure for 1984 is 57 millimeters less than the next lowest figure in the last 25 years. Second, there are three sets of years during which rainfall has been virtually constant: 1960-64, 1968-74, and 1978-81. Third, the minimum cumulative rainfall in the period 1975-83 is greater than the maximum cumulative rainfall for 1968-74.

Clearly, more is going on here than random sampling from a stable population, but it is difficult to say more than that. At least, it is hoped that the unusual runs in the series are the result of natural phenomena and not the result of human error.

Considering the statistics, it should be noted that all three series are skewed upward with the mean greater than the median, confirming the generally accepted fact that Kitale rainfall is rarely poor.

These rainfall data tend to support the view that a shortfall as severe as the one in 1984/85 is less likely than 1 in 15, which is the implicit assumption in using the standard error of the estimate from the trend analysis. Thus, a variability around the trend line of about 15 percent seems reasonable, with the component of variation attributable to totally random phenomenon equal to 10-12 percent. As mentioned in the supply response section above, the small amount of supply response will dampen the production instability slightly. Consequently, a figure of 0.10 will be used here.

Own-Price Demand Elasticity

Reference has already been made to the difficulty of doing demand analysis in Kenya. Previous studies (Williamson and Shah 1981; Gerrard 1981) have produced estimates of the own-price demand elasticity for maize ranging from +2.13 to −0.443. It seems best to take a number that is reasonable, given the importance of maize in the Kenyan diet, and use that rather than a number estimated from data that are known to be far from correct. A figure of −0.3 will be used here.

It is important to note that the appropriate number for this analysis is a short-term elasticity and not a long-term number. These two numbers are likely to differ significantly for a staple food in a poor country. The short-run elasticity measures the sensitivity of consumption to immediate price changes. The long-run elasticity measures the sensitivity of consumption to changes in price that remain in effect for a long period of time, allowing consumers to adjust their taste preferences to the price differential.

Equilibrium Price in a Normal Production Year

In the absence of reliable statistics for consumption, the equilibrium price in a normal production year is difficult to estimate. Recent local market prices have been both above and below NCPB official prices (sometimes at the same time in different parts of the country). This indicates that the normal-production-year equilibrium is not far off from the official price. A producer price of $140 per ton is used here, which translates into a producer price of KSh 189 per 90-kilogram bag at an exchange rate of KSh 15 = US$1.

Cost of Storage

Storage costs estimated by the government in 1983 were KSh 27.50 per bag per year, exclusive of interest charges (Kenya 1983b). Assuming a 10 percent rate of inflation for two years and a 1985 exchange rate of KSh 15 = US$1 yields a storage cost of $2.22 per bag in 1985, or $24.65 per ton. A figure of $25.00 per ton is used here.

At this point, then, the problem has been defined, the model set up, and parameters selected. The following chapter presents the results of running the models, including the measurement of trade-offs. Chapter 6 investigates how the price band schemes can be adjusted, given what has been learned from the optimizing model, while Chapter 7 presents conclusions and recommendations.

5

AN EXAMINATION OF PRICE BAND AND OPTIMAL POLICIES

Results of the Price Band Simulation: Overview

Price band policies were simulated with 5, 10, 15, and 20 percent allowable price variation. Stocks were allowed to vary at 10 different levels between zero and 400,000 tons for each price band. A stock variability of zero implies that year-end stocks do not change; consequently, production variability is buffered only by consumption changes and foreign trade. Results reported in this chapter use an own-price demand elasticity of −0.3 and production variability of 10 percent. Tables 16 and 17 in Appendix 1 present results for a demand elasticity of −0.2 and production variability of 12 percent. Three hundred 10-year cycles were run, with the average values of all the cycles appearing in the graphs and tables.

Figure 4 presents the results graphically. The solid lines are termed "trade-off curves." Price variability is held constant on each curve, with the maximum allowable percent price deviation appearing at the bottom of each line. The marked points on each solid line represent, from top to bottom, increasing levels of stock variability. Each curve individually, then, displays the trade-off between fiscal cost and imports for one particular level of price variability.

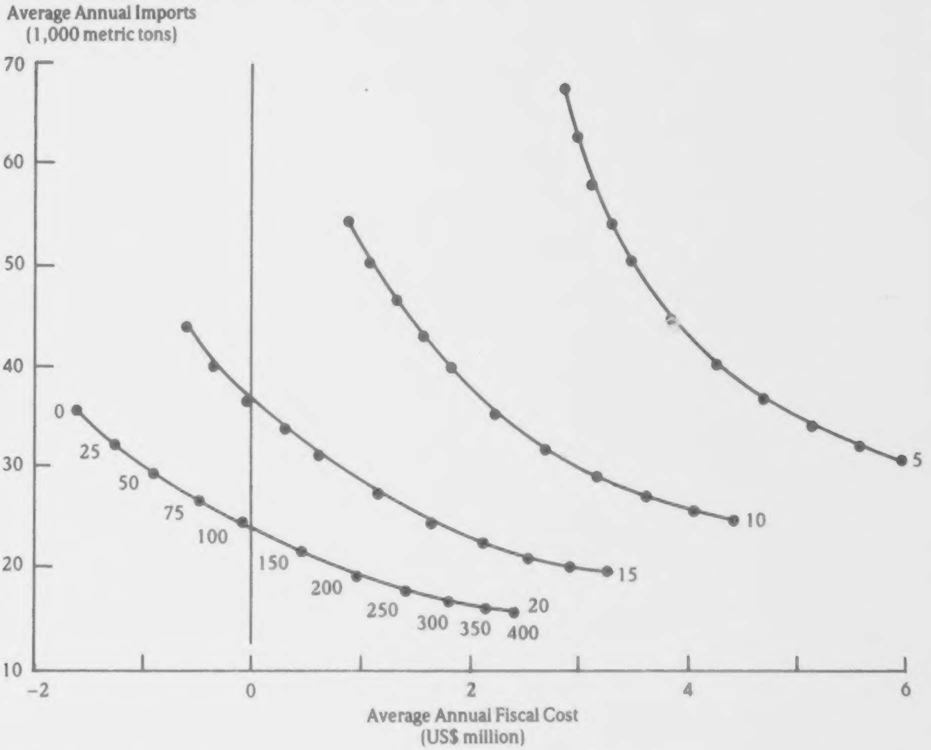
The horizontal axis is the average annual fiscal cost associated with each policy. The vertical axis represents average imports over the 10 years of the simulation. Note that this is different from the average import in importing years. If a price band policy led to total imports of 500,000 tons per 10-year cycle on average, then the figure appearing in the graph would be 500/10 = 50, whether there was an average of 5 years or only 1 year when imports took place per cycle.

There are several important points to notice about the graph before analyzing why the curves are shaped in this way. First, there are large differences in cost and import levels between the different constant price variability curves. Moving from 5 to 10 percent price variability and holding imports constant decreases the average annual cost by $2-3 million. While the degree of leverage that price commands over cost decreases as price variability increases, it remains large; even moving from 15 to 20 percent price variability, with constant imports the difference amounts to almost $2 million annually.

Second, buffer stocks are much more effective at lower levels of price variability than at higher levels. This is apparent from the relative shapes of the constant price variability curves. The 5 percent price variability curve is much steeper than the 20 percent variability curve, implying that increasing stock variability "buys" a large amount of decreased imports for relatively little additional fiscal cost at that price level. Increasing stock variability from zero to 100,000 tons at this price level costs about $30,000 annually per 1,000-ton decrease in average imports. On the other hand, increasing stock variability by the same amount when prices vary by 20 percent costs more than four times as much. Reasons for this are discussed in the next section.

The results are presented numerically in Table 11. The first two columns of the table list the percent price band and the stock variability. Column 3 lists the standard

Figure 4—Price band trade-off curves



Note: The number at the bottom of each line is the maximum allowable percentage deviation from the target price.

deviation of price that corresponds to the percent price variability.[31] Columns 4 and 5 are the coordinates on the vertical and horizontal axes in the figures, the average annual imports and the average annual cost. The standard deviation of the fiscal cost is presented in column 6, while the mean closing stock level at the end of each 10-year cycle is presented in column 7. Columns 8 through 11 list the four components of fiscal cost: returning the stock level to 100,000 tons at the end of each cycle, physical storage costs, losses from trade in the domestic market, and losses from trade in the international market. All monetary figures are in terms of average annual losses; that is, a negative number represents a profit.

The domestic and foreign trade accounts are simply revenues from sales minus expenditures on purchases in each market. The foreign trade account therefore shows the gains or losses in foreign exchange of the different policies. Since it is possible that

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[31] Actually, the number in column (3) is the square root of $\Sigma(P_t - P^*)^2/(N - 1)$. This will differ from the standard deviation of price if the mean of price differs from P^*. This number is called "standard deviation of price" throughout the text.

Table 11—Price band results

							Components of Fiscal Cost			
(1) Price Band	(2) Stock Variability	(3) Standard Deviation of Price	(4) Imports	(5) Average Annual Fiscal Cost	(6) Standard Deviation of Cost	(7) Average Stock Level	(8) Replace Stock Charges	(9) Storage Costs	(10) Domestic Trading Losses	(11) Foreign Trading Losses
(percent)	(1,000 metric tons)	(US$/ metric ton)	(1,000 metric tons)	(US$ million)		(1,000 metric tons)	(US$ million)			
5	0	6.7	67.5	2.88	3.23	0	0.87	0.00	−0.17	2.18
5	25	6.7	62.5	2.98	3.24	13	0.76	0.34	−0.17	2.05
5	50	6.7	58.0	3.12	3.26	26	0.65	0.69	−0.17	1.96
5	75	6.7	54.0	3.29	3.31	38	0.53	1.03	−0.17	1.90
5	100	6.7	50.4	3.49	3.37	51	0.42	1.37	−0.17	1.87
5	150	6.7	44.6	3.85	3.51	77	0.20	1.99	−0.17	1.82
5	200	6.7	40.2	4.25	3.70	103	−0.02	2.59	−0.17	1.85
5	250	6.7	36.8	4.69	3.92	127	−0.24	3.16	−0.17	1.93
5	300	6.7	34.2	5.14	4.17	152	−0.45	3.69	−0.17	2.07
5	350	6.7	32.2	5.56	4.43	176	−0.66	4.17	−0.17	2.21
5	400	6.7	30.7	5.96	4.71	199	−0.86	4.60	−0.17	2.39
10	0	12.8	54.9	0.88	2.86	0	0.87	0.00	−1.01	1.02
10	25	12.8	50.4	1.07	2.88	13	0.76	0.35	−1.01	0.97
10	50	12.8	46.5	1.30	2.94	25	0.65	0.70	−1.01	0.96
10	75	12.8	43.0	1.55	3.01	38	0.54	1.05	−1.01	0.97
10	100	12.8	40.0	1.81	3.09	51	0.42	1.40	−1.01	1.00
10	150	12.8	35.3	2.24	3.27	77	0.20	2.00	−1.01	1.04
10	200	12.8	31.8	2.71	3.50	101	−0.01	2.58	−1.01	1.15
10	250	12.8	29.2	3.18	3.76	126	−0.22	3.12	−1.01	1.30
10	300	12.8	27.1	3.62	4.03	149	−0.43	3.60	−1.01	1.46
10	350	12.8	25.7	4.04	4.32	172	−0.63	4.03	−1.01	1.65
10	400	12.8	24.7	4.41	4.62	195	−0.83	4.41	−1.01	1.84
15	0	18.4	43.9	−0.61	2.58	0	0.87	0.00	−1.53	0.05
15	25	18.4	40.1	−0.34	2.63	13	0.76	0.36	−1.53	0.07
15	50	18.4	36.7	−0.03	2.71	26	0.65	0.72	−1.53	0.12
15	75	18.4	33.7	0.29	2.80	39	0.53	1.08	−1.53	0.20
15	100	18.4	31.2	0.62	2.93	51	0.43	1.44	−1.53	0.28
15	150	18.4	27.5	1.13	3.15	76	0.21	2.03	−1.53	0.41
15	200	18.4	24.7	1.63	3.41	100	0.00	2.57	−1.53	0.58
15	250	18.4	22.7	2.10	3.70	124	−0.20	3.06	−1.53	0.77
15	300	18.4	21.2	2.54	4.00	146	−0.40	3.49	−1.53	0.97
15	350	18.4	20.3	2.93	4.29	169	−0.60	3.87	−1.53	1.18
15	400	18.4	19.7	3.26	4.60	189	−0.77	4.18	−1.53	1.37
20	0	23.5	35.3	−1.63	2.38	0	0.86	0.01	−1.86	−0.64
20	25	23.5	32.0	−1.27	2.45	14	0.75	0.39	−1.86	−0.55
20	50	23.5	29.1	−0.89	2.55	27	0.64	0.77	−1.86	−0.44
20	75	23.5	26.5	−0.50	2.69	39	0.53	1.14	−1.86	−0.31
20	100	23.5	24.3	−0.10	2.85	51	0.42	1.51	−1.86	−0.17
20	150	23.5	21.4	0.44	3.09	75	0.21	2.07	−1.86	0.02
20	200	23.5	19.2	0.95	3.36	99	0.01	2.57	−1.86	0.23
20	250	23.5	17.8	1.41	3.65	121	−0.18	3.01	−1.86	0.45
20	300	23.5	16.8	1.81	3.94	142	−0.37	3.38	−1.86	0.66
20	350	23.5	16.2	2.15	4.25	161	−0.53	3.68	−1.86	0.86
20	400	23.5	15.9	2.43	4.53	179	−0.68	3.93	−1.86	1.04

more physical units could be bought than sold in a market, a profit (loss) alone does not imply that the average selling price is higher (lower) than the average buying price.

Components of Cost for Price Band Schemes

The components of fiscal cost given in Table 11 are useful for analyzing the reasons for the responsiveness of fiscal cost to price variability and stock variability. Replacement costs are straightforward, being related directly to the mean closing stock level. Storage costs are somewhat more complicated. Note that for stock variability levels above 200, storage costs decrease with increasing price flexibility, but for higher levels of stock variability the decrease is larger proportionately than the corresponding change in mean stock level. In addition, the storage costs for 150,000 tons and below increase slightly with increasing price variability.

Both of these outcomes are the result of the opening stock level of 100,000 tons. The storage costs are the sum of the average closing stock level in each year multiplied by the cost per ton. For the 200,000-ton level of stock variability, the opening stock level is quite close to the average stock level; thus the proportionate change in storage costs is close to the change in closing mean stock level. On the other hand, the 300,000- and 400,000-ton stock variabilities generally have lower than average stock levels for the first few years of the simulation, and the stock level will remain low for more years when price variability is higher (since the government intervenes less often). The corresponding effect on the other side causes storage costs for lower levels of stock variability to be higher when prices are more flexible. Thus the storage costs differ from a straightforward multiplication of closing stock times average cost because the mean stock level in early years of the cycles differs from the mean stock level at the end of the cycles.

Domestic trading gains are determined by the difference between buying price and selling price and the amount of government intervention. With higher levels of price flexibility, the government makes more money whenever it buys one year and sells the next.

The foreign exchange account is the most complex. Recall that this account is the cost of imports (including aid) minus the cost of exports. This account is particularly difficult to understand for two reasons: the volume df imports may differ considerably from the volume of exports, and small volumes of exports are sold at a premium.

There are several characteristics of the foreign exchange account to notice. First, with 20 percent price flexibility, foreign exchange losses increase with increased stock variability. This result holds true for the higher levels of stock variability at 5, 10, and 15 percent price flexibility, but in each case foreign exchange losses decrease for the lowest levels of stock variability. Nevertheless, in every case foreign exchange losses are larger for the *lowest* level of imports—that is, for the highest level of stock variability—than they are for the *highest* level of imports. Thus, at some point for each level of price variability, reducing imports implies *losing* foreign exchange.

This conundrum is best understood by examining the relationship between average closing stock levels, imports, and exports. For the price band regimes, the width of the price band alone determines the government purchases. Consequently, the same amount is bought and sold in the domestic market regardless of the stock triggers for imports and exports. So alternative policies that differ only in stock variability would have equal net domestic purchases over any time period; closing stock levels, therefore, can differ only because of differences in net imports. This implies that over the same sequence of production years, the total volume imported minus the total volume exported minus the closing stock level is the same for all policies with the same price variability. Since increasing stock variability increases closing stocks and decreases imports, it must decrease exports by the sum of those two amounts, thereby decreasing export volume by a larger amount than import volume. Since the marginal decline in imports that results from increasing stock variability decreases as stock variability becomes large, while the increase in stock level is close to uniform, the relative effect on net export volumes increases.

If the difference between export and import parity were slight, the foreign-trade account would always lose money when stock variability increases. Since import parity is in fact considerably higher than export parity, this account begins to lose money with increasing stock variability only when the ratio of the decrease in export volume to the decrease in import volume is greater than the ratio of import parity price to export parity price.[32] This does not occur until stock variability reaches about 150,000 tons when the price band is 5 percent, but occurs at all levels of stock variability when the price band is 15 or 20 percent.

So at this point the components of cost of the price band schemes have been analyzed. Trade-offs between government objectives as measured by the price band schemes are presented in the next chapter, after an examination of the results of the dynamic programming runs.

Optimization Results: Overview

Results of the dynamic programming policies are presented in Figure 5 and Table 12. For sensitivity analysis, similar tables for a demand elasticity of −0.2 and production instability of 12 percent are presented in Appendix 1, Tables 18 and 19. Each line of the tables displays the results of an optimization run with a different objective function. The producer/consumer surplus model appears at the bottom of Table 12. All other runs differ only in the weights applied in the objective function to the three different objectives. The weights have been chosen so that the standard deviation of price is constant for four sets of weight combinations. An attempt was made to make the average imports exhibit approximately the same range as occurs in the price band simulations.

As stated above, dynamic programming produces a set of optimal values of the policy variables for each possible combination of production, world price, and opening stock. These discrete policies are then interpolated to make them continuous, and the interpolated policies simulated in the same way as the price band policies are simulated. Thus the results for the optimal policies are directly comparable with those for the price band policies. Figure 5 differs from Figure 4 only in that the number at the base of each line in the price band figures is the maximum allowed percentage deviation in price; in the optimal policy figures, the number is the standard deviation of the price, which will be termed the level of price variability. The corresponding number for the price band schemes can be read from Table 11.

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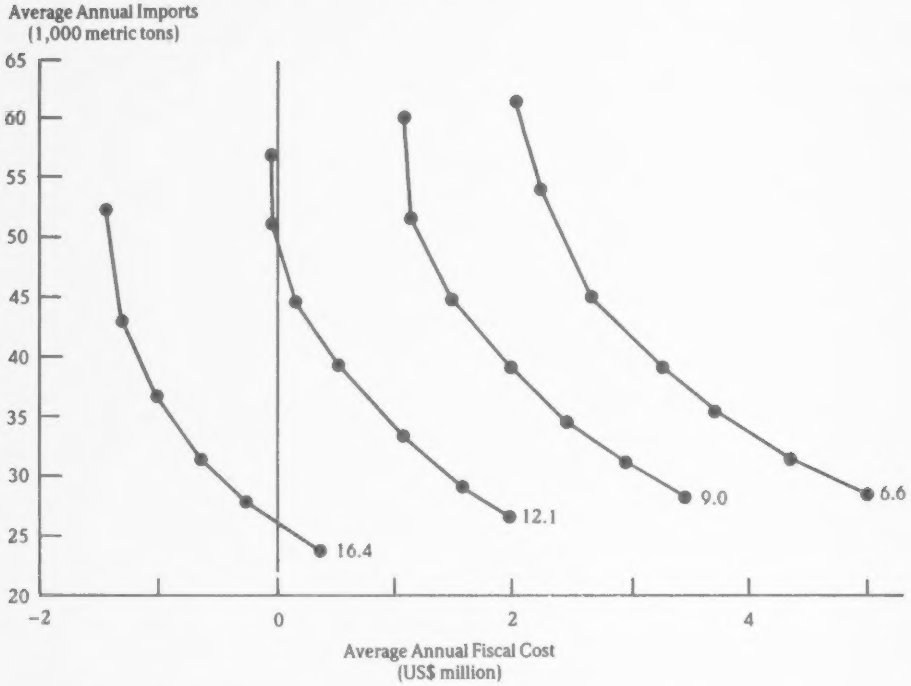
[32] This statement is exactly true if import and export parity prices are constant across different levels of stock variability. In actuality, the situation is slightly more complicated, since average export and import prices also vary with increasing stock variability, as higher stock levels lead to less food aid and a change in the proportion of exports that are sold at a premium. But these price changes are relatively small (5-7 percent between stock variabilities of 0 and 400,000 tons).

Figure 5—Optimal policy trade-off curves



Note: The number at the bottom of each line is the standard deviation of price in dollars per ton.

The price variability levels in Figures 4 and 5, however, are not identical. Consequently, Figure 6 presents price band trade-off curves for which the levels of price variability are the same as in Figure 5. Table 20 in Appendix 1 presents the results for these price band policies numerically. Figure 7 displays a price band and an optimal policy with the same standard deviation of price for direct comparison.

The first two columns differ between the tables for price band policies (Table 11 and appendix Tables 16, 17, and 20) and the tables for the optimal policies (Table 12 and appendix Tables 18 and 19). In the price band tables these are the percent price band and the maximum stock variability; for the optimal policies, these columns are the weights in the objective function on price stability and imports, respectively. Recall that fiscal cost, being the numeraire of the objective function, is not explicitly weighted; its weight results from changes in the combined level of the other two weighting parameters. For example, the weight on fiscal cost would be halved implicitly by moving from a weighting system of a = 10 and b = 40 to a = 20 and b = 80 (where "a" is the weight on price stability and "b" is the weight on imports).

The producer/consumer surplus maximization model describes the free market solution with no government intervention. With an open economy, average stock carry-out is virtually zero; trade is used rather than stocks to stabilize price. Average annual fiscal cost in this case is private sector "cost" (column 5 in the tables for price band and optional policies). Since the figure is negative, profits of about $3.7 million

Table 12—Optimal policy results

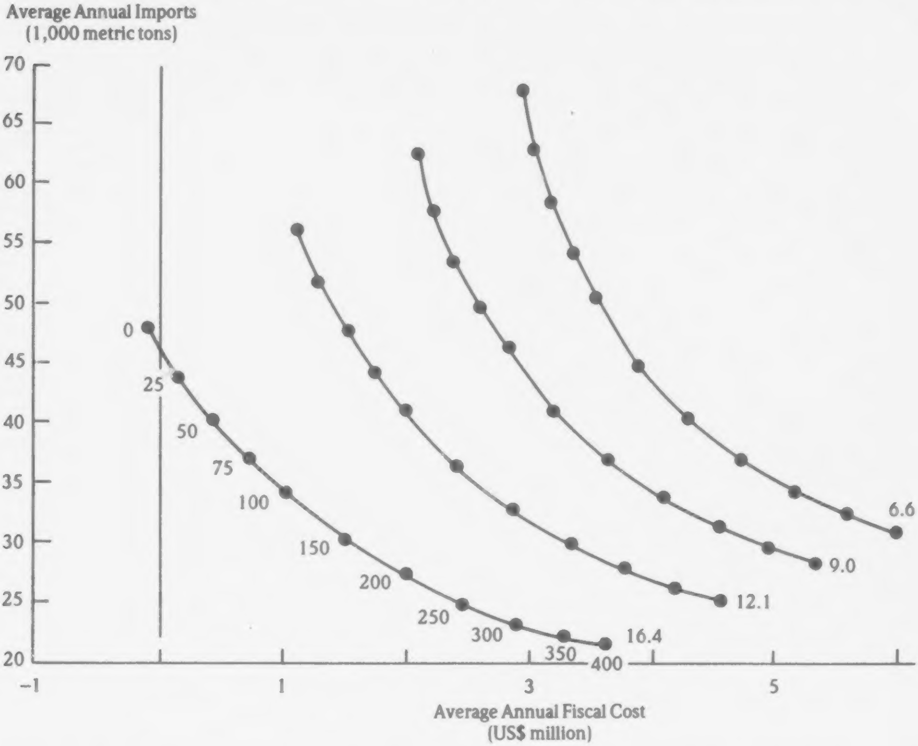
							Components of Fiscal Cost			
(1) Price Stability Weight	(2) Import Weight	(3) Standard Deviation of Price	(4) Imports	(5) Average Annual Fiscal Cost	(6) Standard Deviation of Cost	(7) Average Stock Level	(8) Replace Stock Charges	(9) Storage Costs	(10) Domestic Trading Losses	(11) Foreign Trading Losses
		(US$/ metric ton)	(1,000 metric tons)	(US$ million)		(1,000 metric tons)	(US$ million)			
31.5	0	6.6	61.3	2.03	2.72	36	0.56	0.92	−1.26	1.82
37.3	50	6.6	54.2	2.24	3.08	60	0.35	1.44	−0.62	1.07
40.0	103	6.6	45.0	2.68	3.44	91	0.08	2.14	−0.00	0.48
44.6	149	6.6	39.2	3.27	3.73	117	−0.15	2.76	0.27	0.38
49.0	185	6.6	35.6	3.73	4.03	136	−0.32	3.21	0.55	0.28
53.5	241	6.6	31.7	4.38	4.31	163	−0.54	3.76	0.88	0.28
58.0	287	6.6	28.8	4.99	4.54	184	−0.73	4.24	1.13	0.35
22.0	0	9.0	59.9	1.09	2.39	31	0.60	0.81	−2.08	1.76
23.3	39	9.0	51.7	1.14	2.68	48	0.45	1.20	−1.25	0.75
26.5	80	9.0	45.3	1.48	3.04	67	0.28	1.69	−0.65	0.16
29.2	120	9.0	39.3	1.99	3.33	95	0.05	2.23	−0.15	−0.13
32.0	160	9.0	34.6	2.48	3.62	115	−0.13	2.71	0.27	−0.37
34.9	200	9.0	31.3	2.96	3.89	132	−0.28	3.13	0.52	−0.41
37.5	240	9.0	28.4	3.46	4.15	148	−0.42	3.52	0.85	−0.49
14.2	0	12.1	56.9	−0.04	2.06	24	0.66	0.68	−2.91	1.54
15.3	28	12.1	50.7	−0.03	2.29	36	0.56	0.93	−2.12	0.60
17.0	60	12.1	44.7	0.13	2.56	52	0.42	1.26	−1.48	−0.06
18.8	95	12.1	39.4	0.50	2.90	66	0.30	1.65	−0.99	−0.46
20.9	140	12.1	33.4	1.05	3.20	89	0.10	2.15	−0.29	−0.90
22.9	180	12.1	29.2	1.55	3.48	109	−0.08	2.60	0.08	−1.05
24.9	220	12.1	26.6	1.99	3.72	125	−0.22	2.95	0.53	−1.28
8.9	0	16.4	52.3	−1.46	1.91	16	0.73	0.49	−3.75	1.07
10.4	40	16.4	43.1	−1.33	2.18	31	0.60	0.84	−2.49	−0.27
11.7	80	16.4	36.6	−1.03	2.46	45	0.47	1.16	−1.69	−0.98
13.0	120	16.4	31.5	−0.65	2.80	62	0.33	1.54	−1.03	−1.49
14.3	155	16.4	27.8	−0.26	3.00	77	0.20	1.86	−0.47	−1.85
15.6	200	16.4	23.9	0.31	3.27	94	0.05	2.29	0.09	−2.11
Producer/consumer surplus model		29.0	50.0	−3.69	2.25	3	0.80	0.09	−5.26	0.64

annually are made. Larger domestic profits are offset to some extent by small losses in the other three accounts. The degree to which prices fluctuate, however, is much higher than the historical level, as the standard deviation of price is $29.00 per ton. With fluctuations in the international price and the large difference between import and export parity, trade alone is not able to stabilize price sufficiently. Nevertheless, virtually no storage takes place since the private sector cannot usually expect to profit from storage. Thus there is a clear rationale for some type of government intervention to stabilize price.

Relative Costs of Optimal and Price Band Policies

Tables 11 and 12 and Figure 7 show clearly that on average the optimal policies are less expensive to operate, holding price variability and average imports constant. The broken lines on the graph in Figure 7 show that when average imports are 40,000 tons, the optimal policy costs on average 1.6 million dollars annually less than the price band policy.

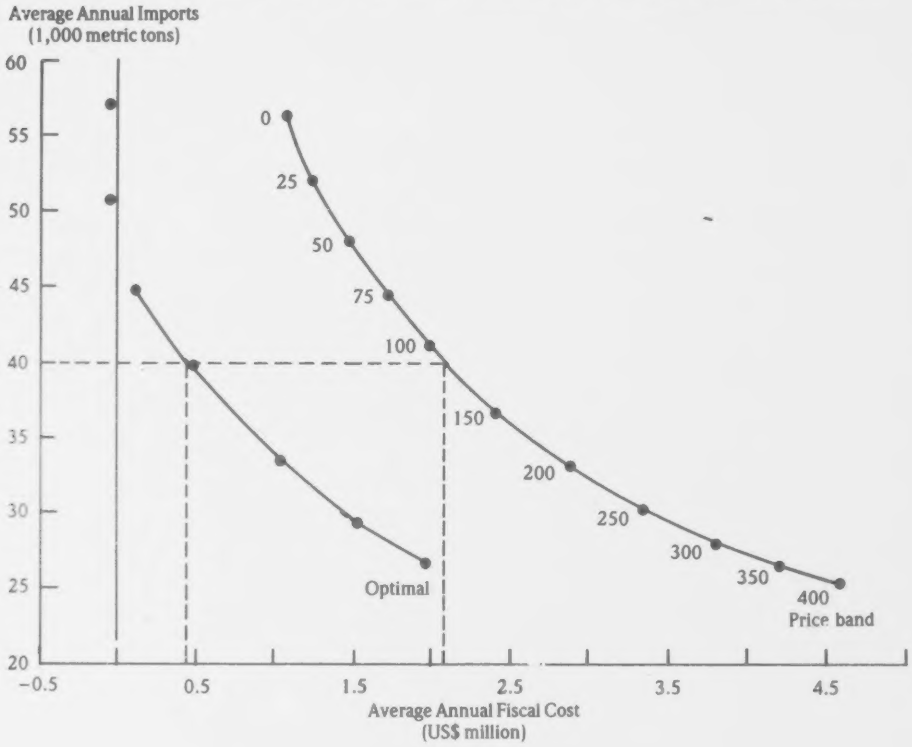
Figure 6—Price band trade-off curves for comparison with optimal



Note: The number at the bottom of each line is the standard deviation of price in dollars per ton.

Average cost differentials, however, may not be statistically significant if the standard deviation of the difference in cost is large. Consequently, costs for each of the 300 10-year cycles for one of the optimal policies were compared cycle by cycle with costs for one of the price band policies. The policies were chosen so that both price variability and imports are equal on average. The chosen optimal policy is the third point from the top on the optimal curve in Figure 7, with a price weight of 17 and an import weight of 60, resulting in average imports of 44,700 tons and a standard deviation of price of $12.10. The chosen price band scheme is the fourth point from the top in the figure (stock variability of 75). The average difference in cost is about $1.6 million annually, with a standard deviation of 1.1. The distribution of the price differential is skewed upward, however, as the median difference is $1.4 million. In the worst case of the 300 cycles for the price band scheme, the optimal policy costs $5.2 million less, which is 3.2 standard deviations from the mean. In the best case for the price band schemes, the optimal policy costs $40,000 more, which is only 1.4 standard deviations from the mean. The price band policy actually costs less than the optimal policy in 17 out of the 300 cycles, but in each of these cases the difference is small. Thus the difference in cost is significant.

Figure 7—Price band versus optimal policies for price variability of 12.1



The first step in gaining an understanding of these cost differences is to examine the differences in the components of cost. This is followed by a study of the differences in policy structure.

Optimization Results: Components of Cost

In examining the components of cost for the optimal policies, the replacement-of-stock component is directly related to closing stocks, as it is for the price band policies. Storage charges are actually simpler than in the price band schemes, being related almost directly to the mean closing stock level. Since the optimal policies produce the best level of each of the control variables for every possible stock level, the system is not in a state of disequilibrium at the start, as was the case for some of the price band policies.

Domestic trade looks considerably different than it does under the price band policies. This account actually loses money if the government has a relatively strong preference for reducing imports or stabilizing prices. This is not a case of the marketing board buying maize at a high price and selling it at a low price. Rather, the optimal policies adjust to government preferences by buying more than they sell domestically. This raises prices on average—which the government does not want—but also results in higher average stock levels, thereby improving the government's ability to cushion production fluctuations from stocks rather than from imports. This is advantageous given some patterns of relative preferences for the three objectives. For the price band schemes, average prices cannot be raised no matter what the preferences of the government are, since the policies are constrained to buy and sell approximately equal quantities domestically.

As with the price band schemes, the foreign exchange account is the most difficult to understand. One trend is clear: as the weight on price stability increases, the foreign exchange account loses more money. This is true across all levels of weights, elasticities, and production variabilities. As mentioned above, the government's preference for stable prices acts as a constraint that keeps the policy from responding flexibly to world price or stock level. The government must import more at unfavorable prices than previously, in addition to holding more stock and thus exporting less.

The foreign exchange consequences of increasing the desire of the government to minimize imports are less clear. The effect on domestic trade, noted above, is to exchange increased price stability in surplus years for decreased stability in deficit years, thus holding average price variability constant. This adjustment on the domestic side complicates the simple relationship between stocks, imports, and exports that explains the foreign exchange account of the price band schemes.

It is important to distinguish methods being used to decrease imports in the optimal and price band schemes. For the price bands, the mechanism is to use one tool, stock variability, which is subject to decreasing returns to scale and which actually decreases exports more than imports. For the optimal policies, the penalty on imports is direct, and thus in general the effect on imports is stronger than the effect on exports; the tables therefore show decreasing foreign exchange losses (or increasing profits) in the trade account as the weight on imports increases. It is not until the model is constrained by high weights on both price stability and imports that the mechanism described above for the price band schemes becomes dominant, with exports declining more than imports because of an increase in stockholding.

So the cost components of the optimal policies are quite different from those of the price band schemes. These result from differences in the way the two types of policies respond to production, world price, and opening stocks. An examination of these differences is conducted in the next section.

Differences Between Price Band and Optimal Policies

The best way to gain an intuitive understanding of the differences between price band and optimal policies is, first, to examine how the policies differ in a particular cycle of state variables; second, to examine the average relationships between state variables and control variables under the two policies. These will be discussed in turn.

Table 13 presents the results for a price band policy and an optimal policy that have similar values for imports and price variability on average. During the 300 10-year cycles of the simulation, both policies yield a standard deviation of price of $12.10 and average imports slightly greater than 44,000 tons. But as the table shows, in any one year the policies may produce very different results.

Since the random number generator for this cycle has produced high world prices, the optimal policy imports less than the price band policy (on average, with these two specific policies imports will be equal). The optimal policy virtually breaks even over these 10 years, while the price band policy loses about $1.4 million annually on average. The difference between the policies, however, is not spread out evenly over every

Table 13—Simulation of price band and optimal policies: one cycle

Year	Production	World Price	Net Purchases	Domestic Price	Net Imports	Closing Stocks	Annual Cost[a]	Sum of Costs
	(1,000 metric tons)	(US$/ metric ton)	(1,000 metric tons)	(US$/ metric ton)	(1,000 metric tons)	(1,000 metric tons)	(US$ million)	
Price band policy[b]								
0	. . .	. . .	. . .	. . .	. . .	100	. . .	. . .
1	2,047	133	−139	154	39	0	−13.83	−13.83
2	2,351	118	37	127	0	36	5.20	−8.63
3	2,306	125	0	129	0	36	0.79	−7.84
4	2,323	144	9	127	0	44	1.79	−6.06
5	2,622	161	308	127	−276	75	3.69	−2.37
6	2,836	154	522	127	−521	75	5.63	3.25
7	1,754	181	−432	154	357	0	−1.86	1.39
8	2,432	169	118	127	−42	75	6.06	7.45
9	2,349	114	35	127	−34	75	1.54	8.99
10	2,142	124	−44	154	0	31	−3.26	5.73
Replace stock adjustment	. . .	. . .	. . .	. . .	. . .	. . .	4.50	10.23
Average annual cost	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1.36
Optimal policy[c]								
0	. . .	. . .	. . .	. . .	. . .	100	. . .	. . .
1	2,047	133	−140	154	40	1	−13.51	−13.51
2	2,351	118	79	136	−74	6	2.40	−11.16
3	2,306	125	43	137	−44	5	0.65	−10.46
4	2,323	144	61	138	−66	0	−0.76	−11.22
5	2,622	161	313	129	−182	132	14.91	3.69
6	2,836	154	500	124	−486	146	6.80	10.49
7	1,754	181	−384	166	238	0	−18.04	−7.55
8	2,432	169	160	136	−133	27	0.94	−6.61
9	2,349	114	73	135	−60	39	2.91	−3.70
10	2,142	124	−48	153	8	0	−3.18	−6.87
Replace stock adjustment	. . .	. . .	. . .	. . .	. . .	. . .	6.53	−0.35
Average annual cost	. . .	. . .	. . .	. . .	. . .	. . .	. . .	−0.05

[a] Annual costs include a discount factor of 7 percent per year beginning in year 2.
[b] The price band policy has maximum price flexibility of 9.37 percent and stock variability of 75,000 tons.
[c] The optimal policy has a price weight of 17 and an import weight of 60.

year; for these 10 years, the optimal policy costs considerably less four times, the two are almost equal three times, and the price band policy costs less three times.[33] However, it is partly because the price band policy costs less in years 5 and 6 (because it exports more and stores less) that it is so far inferior to the optimal policy in year 7. The policies cannot be compared except in a dynamic context.

Although the price variability levels are equal on average for these two policies, the distribution of prices is strikingly different. For the 10 years in the table, the price band policy is at either the low or high extreme nine times, while the optimal policy prices are more spread out. Figures 8 and 9 present frequency histograms of price for all 3,000 simulated years (300 10-year cycles), using the same two policies as in Table 13. Note that the scale is different in the two histograms. The price band histogram shows that in 80 percent of the years the price is at either the maximum or minimum allowed value. The optimal policy is also bimodal, but much more dispersed. Although the price component of the objective function is equal for these two policies, if govern-

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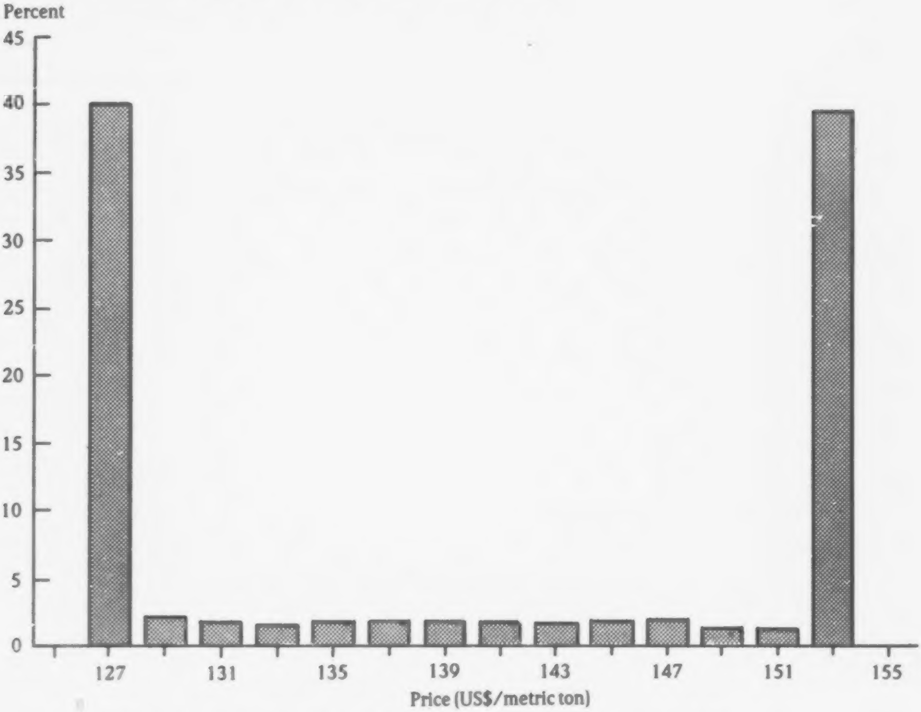
[33] Annual comparisons are obscured by the lack of any adjustment for differences in closing stock level. The adjustment is made at the end of the tenth year.

Figure 8—Price frequencies: price band policy



Note: Price variability = 12.1, demand elasticity = −0.3, production variability = 0.10.

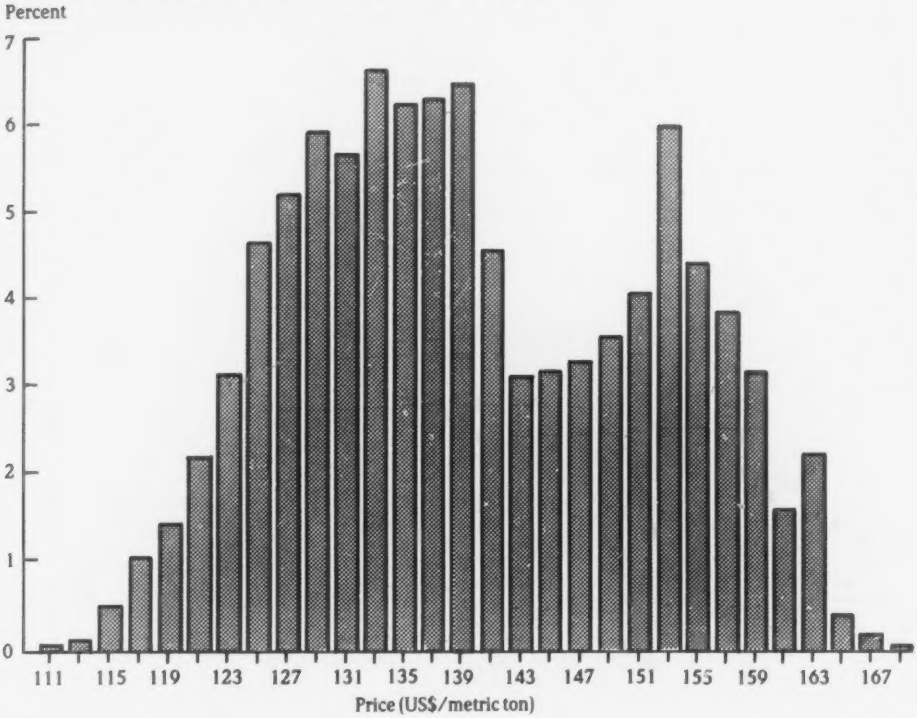
ment preferences have not been modeled accurately by the objective function, it is quite possible that one distribution of prices would be preferred over the other.

Government net purchases determine the domestic price. Net purchases and trade are the two control variables for the stockholding agency. For the price band policies the decisions are sequential, with the trade decision following the net purchases decision. The optimal policy decision will also be treated as sequential in order to facilitate the comparison with the price band policy, although in the optimization process the two are chosen simultaneously.

Figure 10 shows the relationship between production and net purchases for a price band rule that results in a price variability of $12.10 and an optimal policy with the same price variation. Unlike the price band schemes, the net purchases in the optimal policies are sensitive to opening stocks, world price, and the objective function weights; the optimal relationship shown is for opening stocks of zero and a world price of $100.00 per ton for the same objective function weights considered above (price weight of 17, import weight of 60). As mentioned in Chapter 3, the price band policy has three linear sections, with slopes of one, zero, and one. The optimal policy, on the other hand, is a smooth curve that is close to being linear.

The two curves are close together with the exception of the rare case of very high production. It would be surprising if differences of the magnitude shown on the graph

Figure 9—Price frequencies: optimal policy

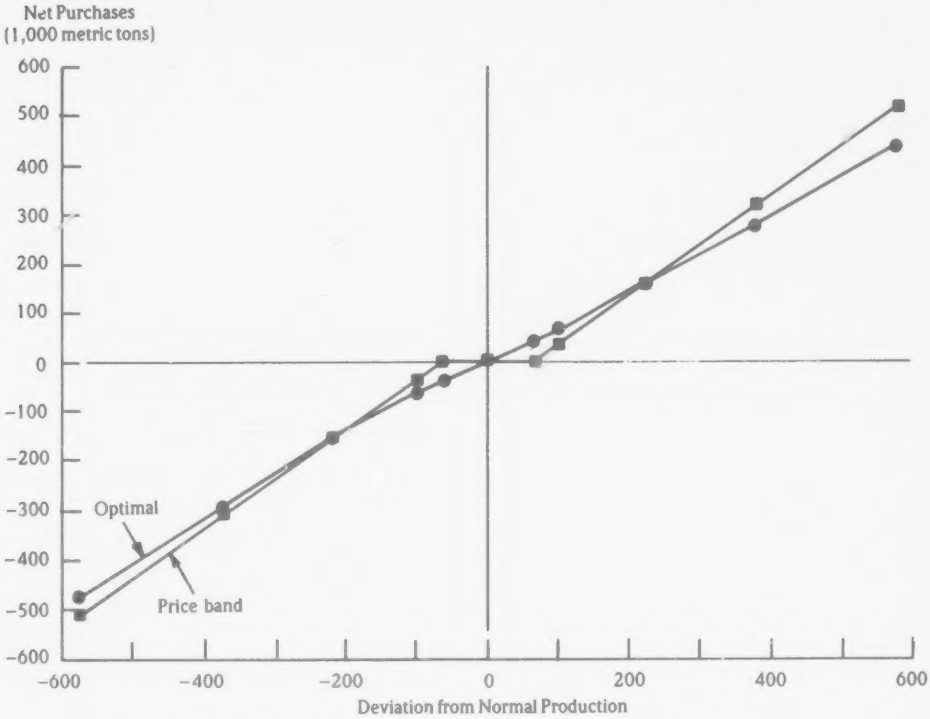


Note: Price variability = 12.1, demand elasticity = −0.3, production variability = 0.10.

produced such large differences in cost. But consider Figure 11, which displays the same case as Figure 10 except that opening stocks are 400,000 tons rather than zero. The price band curve does not change from one figure to the next since purchases are not sensitive to opening stocks in these schemes. But the optimal policy has changed considerably, leading to large differences between the curves in the frequent case of production being slightly below normal. This confirms that the major problem with price band schemes is the absence of flexibility to opening stocks and other state variables.

The way that the optimal policies respond to changes in government preferences is displayed in Figure 12. The curve displayed with diamonds and labeled "base" is the case considered above: a price weight of 17 and an import weight of 60, yielding price variability of $12.10 and average imports of 44,700 tons. This will be termed policy 1. The curve displayed with bullets and labeled "low imports" has a price weight of 24.9 and an import weight of 220. This policy, called policy 2, produces the same price variability as policy 1, but average imports of only 26,700 tons. The third curve, displayed with squares and labeled "low price variability" is called policy 3. It displays results for a price weight of 40 and an import weight of 103, yielding virtually the same level of imports as policy 1, but price variability of only $6.60 per ton. The displayed curves are all for a world price of $100.00 and opening stocks of 100,000 tons.

Figure 10—Net purchases: price band versus optimal for opening stock = 0

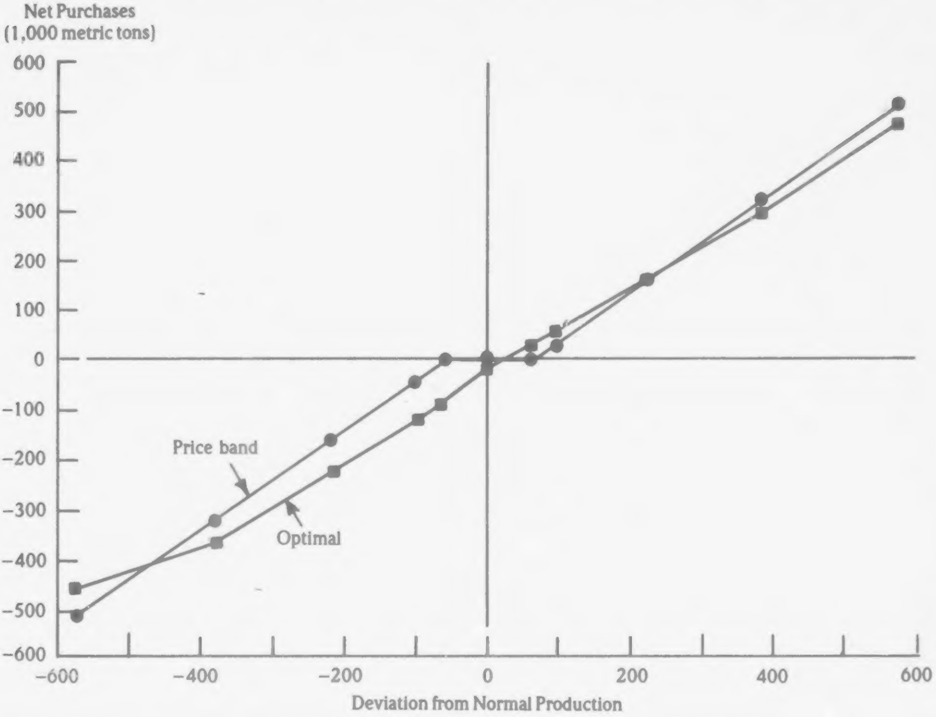


Note: Demand elasticity = −0.3, production variability = 0.10, and world price = US$100.

All of the policies have the same net purchases when production is between its mean value and 100,000 tons less than the mean, with each policy making up the entire difference between actual and normal production in such years. With these exceptions, however, the curve for policy 2 is always above the curve for policy 1, implying that more is bought in high production years and less is sold in low production years. Such a policy clearly leads to lower imports. The curve for policy 3, on the other hand, is below the policy 1 curve in low production years and above it in high production years. There are thus more purchases in high production years and more sales in low production years, leading to greater price stability. The larger stockholdings gained through higher purchases, however, do not reduce imports on average, because larger amounts of grain are required for sale in deficit production years.

Once net purchases are determined, the stockholding agency is left with a quantity equal to opening stocks plus net purchases, which will be termed "available supply." Imports and aid are brought in to make up the deficit exactly if the available supply is negative. Positive available supply can be either stored or exported. The relationships between available supply, closing stocks, and exports are displayed in Figure 13 for

Figure 11—Net purchases: price band versus optimal for opening stock = 400



Note: Demand elasticity = −0.3, production variability = 0.10, and world price = US$100.

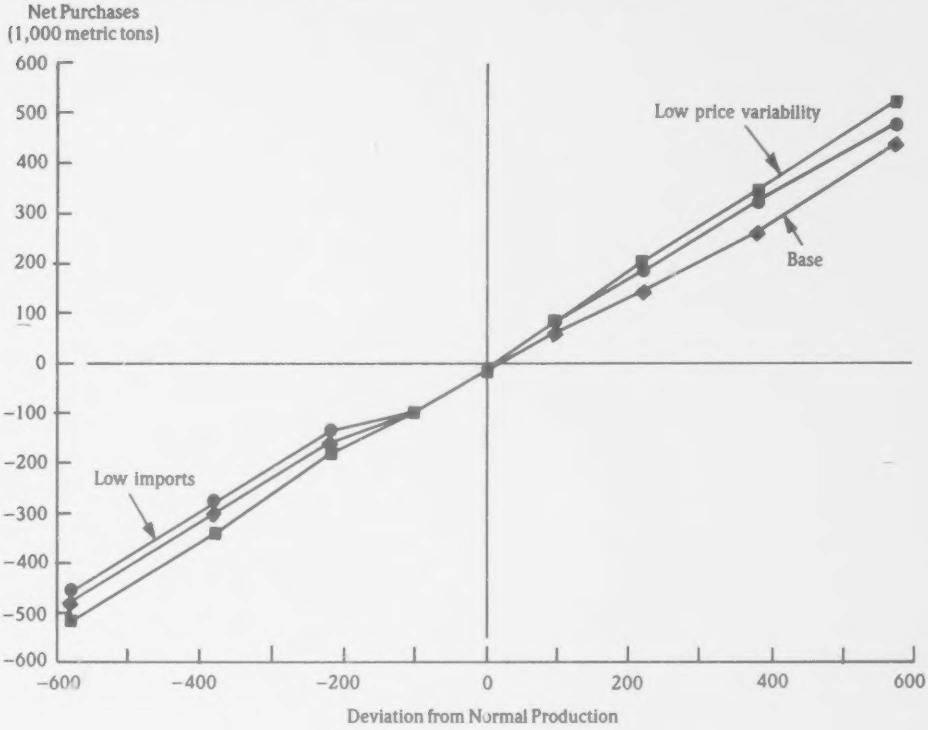
policy 1 from the net purchases analysis: world price equal to $100.00, price weight equal to 17, and import weight equal to 60.

Each curve has three segments that are almost linear. The stock curve rises with a slope of 0.5 until stocks reach 100, then rises with a slope of 1.0 until stocks reach 340, and then flattens out. Since whatever is not held as a stock is exported, the export curve also has three sections, with slopes of 1.0 minus the slope of the stock curve. It is clear that the value of holding stocks when available supply is low is approximately equal to the value of exporting at the prevailing premium price; when the export premium decreases at 100,000 tons of exports, stocks absorb all additional supply until the marginal value of holding additional stocks is smaller than the export price without the premium.

This stock curve for a world price of $100.00 is contrasted to the stock curve for a world price of $140.00 and the price band/buffer stock curve in Figure 14. Of course, additional curves could be included for price band policies with different levels of stock variability, but the shape would be the same.

The two optimal policy curves are similar in shape, with two important differences. First, the maximum stock level is much lower for a world price of $140.00 per ton

Figure 12--Optimal net purchases for different objective function weights



than it is for a world price of $100.00. This reflects the increased opportunity cost of stocks with higher world prices. Also, at higher world prices, 1 ton of exports is worth a larger fraction of a ton of future imports, since with higher world prices and a constant price differential the ratio of export parity to import parity increases. The second difference between the curves is that at the higher price, 80,000 tons of exports take place before any supply is placed in storage. Thus the marginal value of the export premium sales is higher than the marginal value of the first units of storage.

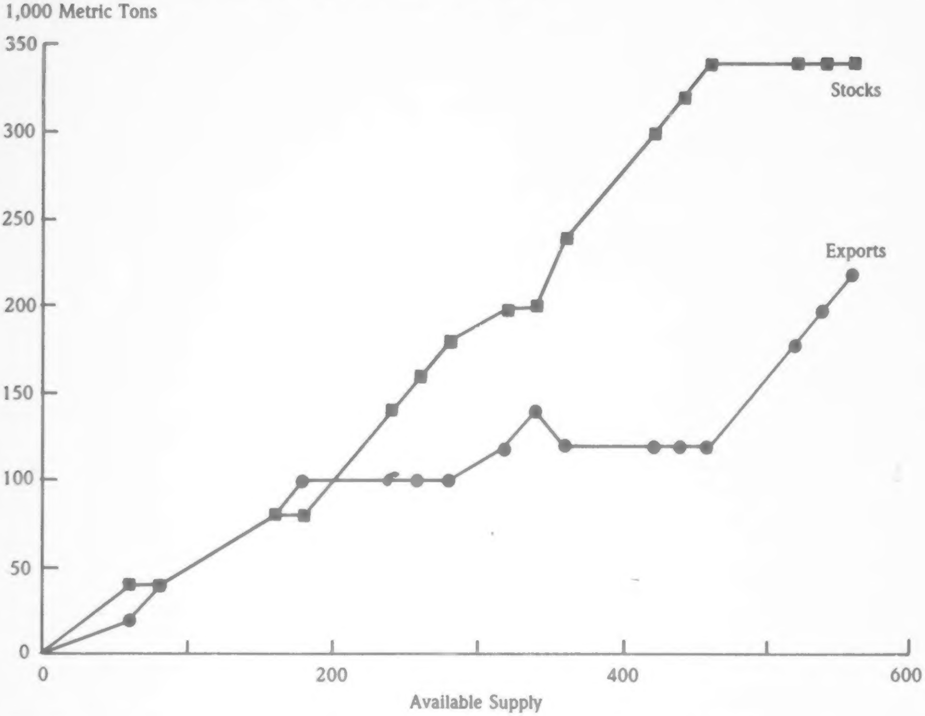
Both of these curves are in contrast to the price band curve, which simply places all supply into storage until the maximum stock is reached, and then exports the remainder. Two limitations of such a policy are clear: it ignores the presence of export premiums on small quantities of exports, and the maximum stock level is independent of world price.

Summary of Major Results

The major results from this chapter include the following:

1. The frequency distribution of price that results from a price band policy is quite different from the distribution under an optimal policy even when the standard deviation

Figure 13—Optimal closing stocks and exports



Note: Demand elasticity = −0.3, production variability = 0.10, and world price = US$100.

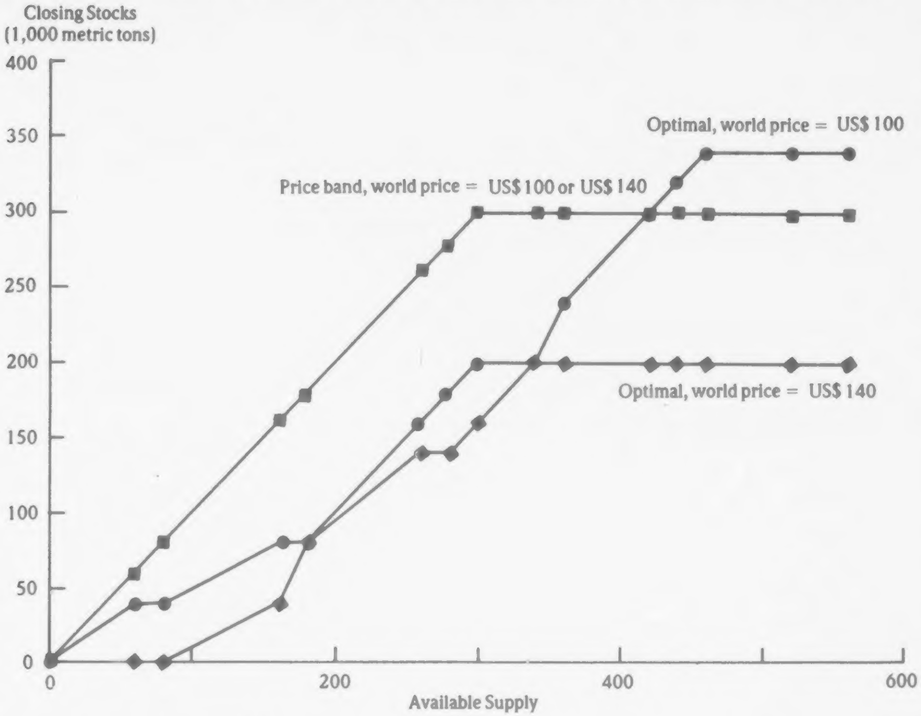
of price is held constant. For the price band policies, the distribution is strongly bimodal with a large majority of the prices at the extreme price limits. The optimal policies yield a relatively smooth distribution of prices.

2. The optimal policy net purchases (and thus domestic price) respond to world price and opening stock level, while net purchases for the price band schemes do not respond to those variables. By buying less (more) when world prices are high (low) and opening stock levels are high (low), the optimal policies save on fiscal cost.

3. The relationship between production and net purchases for the optimal policies is smooth, while it is kinked for the price band policies. The kinked relationship of the price band policies implies that the marginal cost of the next dollar price change at the limits is infinite; since this is not the case according to the objective function used here, the price band net purchases curve is inefficient.

4. The optimal export function is sensitive to world price in two ways: 100,000 tons of maize are exported before the maximum stock level is reached, and the maximum stock level itself is sensitive to the world price. The first 100,000-ton lot is exported to take advantage of the available export premiums. The maximum stock level adjusts, since the volume of future imports that can be bought with the cash gained from 1

Figure 14—Stocks: optimal versus price band policy at different world prices



Note: Demand elasticity = −0.3, production variability = 0.10.

ton of this year's exports increases with increasing world price. Thus the opportunity cost of holding stocks increases with higher world prices.

With these results in hand, the following chapter examines the trade-off between complexity of policy and cost. Based on the differences between the optimal and price band policies outlined above, changes are made in the price band policies to increase their efficiency. Chapter 7 presents policy recommendations and recommendations for policy analysts.

6

TRADE-OFFS BETWEEN GOVERNMENT OBJECTIVES

Trade-Offs Between Cost, Price Stability, and Imports

Figures 4 through 7 in Chapter 5 display the trade-off curves implied by the different policies. Since these can be slightly misleading for the purpose of measuring trade-offs, the results are presented numerically in Table 14. Trade-offs for price elasticity of −0.2 and production variability of 12 percent are presented in Appendix 1, Tables 21 and 22. As discussed above, buffer stocks are more effective at lower levels of price variability. The curves become steeper between corresponding levels of stock variability as price variability is decreased. This occurs because the slope of the line measures the relative effectiveness of only one instrument, increasing stock variability, which is subject to diminishing returns. With the optimal policies, on the other hand, all policy instruments can be adjusted simultaneously, and the least expensive adjustments are made. But with higher weights on price variability, the costs of making even minor adjustments in consumption are high, so the algorithm is constrained in the way it can adjust to a higher weight on imports. This leads to flatter curves for the low levels of price variability.

Such considerations can lead to the false conclusion that, for the price band schemes, the cost per unit decrease in imports declines with increasing price stability. This is not true, as Table 14 clearly shows, because as prices become more stable, higher

Table 14—Trade-offs between objectives: price band and optimal

Trade-off	Standard Deviation of Price			
	16.4	12.1	9.0	6.6
		(US$1,000/year)		
Cost per 1,000-metric-ton decrease in average annual imports				
As imports decline from 48,000 to 40,000 metric tons				
Price bands	69	76	75	82
Optimal policies	27	52	75	81
As imports decline from 40,000 to 31,000 metric tons				
Price bands	121	136	166	202
Optimal policies	73	110	134	167
Cost per US$ decrease in standard deviation of price				
With imports held constant at 48,000 metric tons				
Price bands	...	368	399	410
Optimal policies	...	335	417	501
With imports held constant at 31,000 metric tons				
Price bands	...	409	476	551
Optimal policies	...	451	540	630

levels of stock variability are required to maintain the same import level.[34] Although the line from 100,000 to 200,000 tons of stock variability is steeper with a smaller price band, the curve moving from imports of 40,000 to 31,000 is not.

The table confirms the impression of Figures 4 through 7 that for both the price band schemes and the optimal policies, price variability is the key determinant of cost. Each dollar decrease in price variability between $9.00 and $6.60 costs about $500,000 annually for the optimal policies with imports held constant at 48,000 tons; the figure is $630,000 when imports are held constant at 31,000 tons.

The cost of decreasing imports, while not as large in absolute terms as the cost of decreasing price variability, undergoes a larger percentage increase, rising from less than $30,000 annually to almost $170,000. The marginal cost increases as price stability increases, and also increases as imports decline.

With a few exceptions, the price band schemes overestimate the cost of decreasing imports. The price band estimates of the trade-off between lowering imports and lowering fiscal cost are particularly far off for high price variability. In this case, the optimal policies decrease imports by raising average prices. When the government preference for low imports is sufficiently high, this is preferred even though average prices are above the target price. On the other hand, with the width of the band held constant, the price band policies can reduce imports only by raising stock levels. This is very inefficient when prices are allowed to fluctuate widely.

In contrast to the fiscal cost/import trade-off, the trade-off between cost and price variability is almost always understated by the price band policies. The degree of underestimation increases as price variability declines. This appears to suggest that the price band schemes are more efficient at decreasing price variability than are the optimal policies.

But this is not the case. The optimal policies are the most efficient way to maximize the three objectives for any set of government preferences. Thus, the optimal policy measurements of the trade-offs are accurate. The reason for the relatively flat relationship between price variability and cost per unit of decrease in the price band schemes is that, as mentioned above, buffer stocks are more efficient policy instruments when prices are relatively stable. As price variability decreases, the price band curve gets closer to the optimal curve, biasing the measurement of the trade-off downward.

The Trade-Off Between Complexity and Cost

As shown above, the optimal policies achieve the government's objectives more efficiently than the price band policies. Despite these large differences in efficiency, several stockholding agencies in different parts of the world attempt to implement price band/buffer stock plans, while "in actual formulation of stockpiling strategy either at the national or at the international level . . . these [optimal stockpiling] models have barely been consulted" (Bigman and Yitzhaki 1983, 1). Cochrane (1980) suggests that risk considerations tend to make price band schemes with their floor and ceiling prices more intuitively appealing to both producers and consumers than the smooth intervention rules called for by optimal stockpiling analysis. Although the infinite marginal value attached to the next incremental price change in a price band scheme seems irrational to an economist used to marginal analysis, the revealed preferences of governments around the world appear to be in favor of such schemes.

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[34] Trade-offs for demand elasticity of −0.2 and production variability of 12 percent are presented in Appendix 1, Tables 21 and 22.

One compelling reason why optimal policies have never been implemented is the difficulty in communicating what they are. Indeed, the interpolated policies from the dynamic programming analysis are difficult to describe and implement. Savvy decisionmakers who have seen complex cure-all projects disintegrate into chaos are likely to agree with Chambers' (1978) dictum that "simple is optimal" in policy design as well as in project selection, and to be wary of a policy that is difficult to describe, even for its proponents. Furthermore, the process of formulating public policy is so complex that policies that are difficult to communicate are unlikely to be accepted at the many decisionmaking levels necessary for successful implementation. There is thus an additional trade-off that needs to be examined here: the trade-off between the complexity of a policy and its efficiency. Apparently, the efficiency gains from optimal policies have not been sufficient to outweigh the costs involved in attempting to gain approval for and implement a complex policy.

Thus, if optimal stockpiling analysis is to have an effect on policy, it is likely to be through the clues it provides for modification of price band policies, or through the formulation of a relatively simple policy that is close to the optimal policy in most circumstances.

Possible modifications to the price band policies are suggested by the differences between the optimal and price band policies discussed in Chapter 5. Four differences have been identified: the maximum stock level in the optimal policies is dependent on the world price, with lower maximum levels prevailing at higher world prices; 100,000 tons of grain are exported before the maximum stock level is reached in order to take advantage of export premiums; net purchases of the stocking agency are sensitive to opening stocks and the world price; and net purchases are almost linearly related to production for constant opening stock level and world price. These four elements account for the large difference in efficiency between the two curves.

Learning from the Optimal Policy

One approach to the formulation of a relatively simple and efficient policy is to introduce the components of the optimal policy into the price band policy one by one, and measure the gain in efficiency at each step. For example, the first step could be to make the maximum stock level dependent on the world price. To accomplish this, however, it is necessary to know how sensitive the maximum stock level should be to the world price. Once estimates are made of the degree of sensitivity, the price band policies can be adjusted so that they respond to changes in the state variables to the same extent as the optimal policies.

The first step in the analysis is to choose the specific policy for consideration. The policy with a price weight of 17 and import weight of 60, which yields a standard deviation of price of \$12.10 and average imports of 44,700 tons, will be examined here.

Figures 10 through 12 suggest that the relationship between net purchases and the state variables (world price, opening stock level, and production) is close to linear. The following regression results confirm the suggestion:

$$NP_t = \underset{(6.1)}{-1{,}826.8} + \underset{(0.0194)}{0.5309} \cdot WP_t + \underset{(0.0024)}{0.7847} \cdot Q_t - \underset{(0.0036)}{0.09773} \cdot S_{t-1}; \qquad (25)$$

$N = 1{,}350$, $R^2 = 0.992$, $SEE = 15.98$,

where

NP_t = net purchases,
WP_t = world price,
Q_t = production, and
S_{t-1} = opening stock level.

Standard errors are in parentheses. The regression includes all states in the model except for the extreme world prices of \$60 and \$180, for which the optimal results are not deemed accurate, since world prices cannot go below or above these extremes. Since each state of the world is not equally likely, the observations are weighted by the product of two factors: first, the probability of the production occurring, which is known in the model; second, a linear weighting scheme that decreases with increasing stocks. The second term is not exact, but reflects decreasing likelihood of higher stock levels occurring.[35]

The second important relationship graphed in Chapter 5 is that between available supply and closing stocks (Figures 13 and 14). That relationship, however, appears to be piecewise linear in three segments and thus is not amenable to linear regression. The regression that can be run is maximum stock level on world price. Unfortunately, there are very few observations for this analysis, since the optimizing model considers only seven levels of world price and the two extreme values are somewhat suspect. With only five observations, the result is

$$MXST_t = 652 - 3.3 \cdot WP_t, \tag{26}$$

where $MXST_t$ is maximum stock level. This implies that when world prices are higher than \$198, nothing will be stored.

With these results in hand, the step-by-step analysis of the price band policies can begin. The easiest policies to implement are those that are more or less invisible to the populace if imports are held constant: making the maximum stock level sensitive to the world price and exporting small quantities frequently. These will be discussed in turn.

Surprisingly, the results are only slightly better for the price band with a flexible maximum stock level (policy A) than for the normal schemes. Table 15 lists the components of cost for policy A and the price band scheme with 250,000 tons of stock variability, which has the same level of average imports. Figure 15 displays the result for policy A as the point labeled "A".

As expected, export revenues increase substantially by lowering stock levels when world prices are high. Average export prices increase over 20 percent, but the increased stock level leads to lower export volumes, since imports and domestic trade are constant. The higher stock level leads to higher storage charges that are tempered somewhat by increased "earnings" from the replace stock account. Also on the negative side, average

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[35] The unweighted equation is

$$-1{,}892.7 + 0.6007 \cdot WP_t + 0.8091 \cdot Q_t - 0.0760 \cdot S_{t-1},$$

with a slightly higher R^2. A weighting scheme in which weights were chosen based on how often each state of the world occurs in the simulation was tried also. Results differ only marginally.

Table 15—Adjusting the price band policy

Policy	Import Volume	Average Annual Fiscal Cost	Average Stock Level	Replace Stock Charges	Storage Charges	Domestic Trading Losses	Foreign Trading Losses
	(1,000 metric tons)	(US$ million)	(1,000 metric tons)	(US$ million)			
Price band	30.0	3.35	126	−0.23	3.13	−0.92	1.36
Policy A	30.0	3.27	149	−0.43	3.47	−0.92	1.14
Optimal	30.0	1.45	103	−0.05	2.51	0.01	−1.02
(Policy A makes up 4 percent of the difference)							
Price band	41.7	1.95	49	0.44	1.33	−0.92	1.09
Policy B	41.7	1.37	60	0.35	1.66	−0.92	0.28
Optimal	41.7	0.34	60	0.35	1.48	−1.20	−0.29
(Policy B makes up 36 percent of the difference)							
Price band	42.8	1.86	44	0.48	1.21	−0.92	1.08
Policy C	42.8	1.02	56	0.37	1.62	−0.92	−0.05
Optimal	42.8	0.26	57	0.38	1.40	−1.30	−0.20
(Policy C makes up 53 percent of the difference)							
Price band	41.3	1.98	50	0.43	1.37	−0.92	1.09
Policy D	41.3	1.04	57	0.37	1.64	−0.59	−0.39
Optimal	41.3	0.37	61	0.34	1.51	−1.17	−0.32
(Policy D makes up 58 percent of the difference)							
Price band	41.5	1.97	49	0.44	1.36	0.92	1.09
Policy F	41.5	0.48	54	0.40	1.54	−1.25	−0.21
Optimal	41.5	0.35	60	0.35	1.50	−1.18	−0.30
(Policy F makes up 92 percent of the difference)							

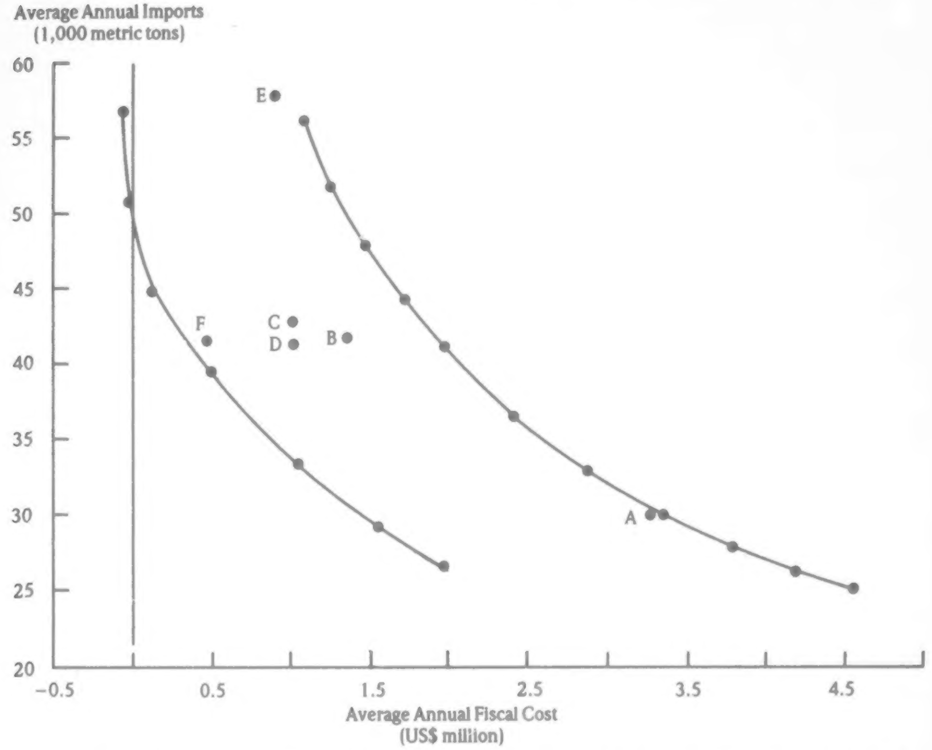
Notes: Policy A is a price band policy modified by the introduction of a flexible maximum stock level. Policy B is policy A modified by allowing half of the first 200,000 metric tons of available supply to be exported. Policy C is policy B modified by making net purchases sensitive to the world price. Policy D is policy C modified by making net purchases sensitive to opening stocks. Policy F is policy B modified by replacing the price band rule with a piecewise linear net purchases function.

import prices increase; this results from more of the imports taking place when world prices are high, since the maximum stock level is lower when world prices are high. The net result of these different factors is a gain of only about $80,000 annually. As the optimal policy achieves the same level of imports for $1.9 million less annually, this adjustment has made up only about 4 percent of the difference.

The next step on the exporting side is to allow the model to take advantage of the export premium that prevails when exports are small. The optimal policies examined in Chapter 5 suggest that a convenient rule of thumb might be to export one-half of the first 200,000 tons of available supply, then put the remainder in store until the maximum stock level is reached. This adjustment has a large payoff, as is evident in Table 15 and Figure 15 (the relevant point is labeled "B" in the figure).

This policy moves much closer to the optimal results, although a significant difference remains. The comparison with policy A is obscured somewhat by the large difference in import volumes, but one major change is that the additional exports in years

Figure 15—Moving toward the optimal: price band policy modifications



Notes: Policy A is a price band policy modified by the introduction of a flexible maximum stock level. Policy B is policy A modified by allowing half of the first 200,000 metric tons of available supply to be exported. Policy C is policy B modified by making net purchases sensitive to the world price. Policy D is policy C modified by making net purchases sensitive to opening stocks. Policy E is Policy D modified by making net purchases sensitive to production. Policy F is policy B modified by replacing the price band rule with a piecewise linear net purchases function.

of relatively low available supply keep export volumes from falling relative to the price band policy, as they did under policy A. Despite the gains made on the foreign trade side, however, a large difference remains between the foreign trade losses under policy B and the profits from trade under the optimal policies. Making the domestic market price sensitive to the world price is one way to close the gap.

Policy C attempts to accomplish that task. The domestic market continues to have a floor and ceiling price with a constant difference between them, but both maximum and minimum trigger prices move somewhat with world prices. This is accomplished in the model by taking the world price coefficient from the net purchases regression estimated above, multiplying it by the deviation of world price from $120.00 (the base world price), and adding the result to the production volume triggers (Q_{min} and Q_{max} as defined in equations (20) and (21) of Chapter 4). The resulting change in the price triggers is not particularly large; in policy C when world prices are at their base of

$120.00, the lower price trigger is $128.10, while the corresponding trigger for a world price of $100.00 is $126.20.[36]

Even these small changes, however, have significant results, with policy C more than 50 percent of the way from the price band scheme to the optimal policy. The major difference between policies B and C is in the price of imports and exports. Since lower volumes are sold domestically when world prices are high and domestic production is low, fewer imports are needed in those years, while relatively more is imported when world prices are low. A similar story can be told for the domestic purchases/export side. Thus, average import prices are about 5 percent lower and average export prices about 4 percent higher under policy C than under policy B.

Despite these gains, the optimal policy remains $750,000 dollars cheaper on average. This results from a combination of higher domestic profits, lower storage charges, and a continued lead in foreign trade despite the substantial gains made. The last remaining way to make the policy more similar to the optimal policy while retaining maximum and minimum prices is to allow the triggers to vary with opening stock.

Policy D, then, makes this change. This is accomplished by multiplying the coefficient from the estimated regression by the deviation of the stock level from 100,000 tons, and adding the result to the volume triggers computed by policy C (Q_{min} and Q_{max}). As in the case of the world price adjustment, the changes in price are not large; an increase in the stock level from 100,000 to 200,000 tons increases the lower trigger from $128.10 to $129.90. Nevertheless, the results are significant if not dramatic, as shown in Table 15 and Figure 15.

Policy D is almost 60 percent of the way from the price band policy to the optimal policy. The change from policy C to D is somewhat different from the expected, however. Considerably lower profits are made domestically under policy D, while the cost of imports drops. The policy has adjusted by increasing domestic purchases when stocks are less than 100,000 tons. Since the greater number of years fall in this range, net domestic purchases have increased, displacing imports and raising the average domestic price slightly. Since domestic maize is cheaper on average than imported maize, this has resulted in some efficiency gains.[37]

Policy D is virtually identical to the optimal policy in the foreign trade account; the remaining differences between the policies are primarily in the domestic account. The next step in trying to approximate the optimal policy is to forgo the idea of minimum and maximum prices altogether. All elements of the regression estimated above have been entered into policy D except the smooth relation between net purchases and production. This is added in policy E.

The result is surprising, as the policy has a cost of $920,000 and average imports of 57,700 tons.[38] As Figure 15 indicates, policy E is only marginally superior to the

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[36] Policies C and D must have a smaller maximum percentage deviation of price in order to achieve the same standard deviation of price. The standard price band scheme requires a percent limit of 9.37 percent to achieve a standard deviation of price of $12.10; the percent limit for C is 8.86 percent, while the limit for D is 8.84 percent. The percent variability allowed must be adjusted because of the price flexibility that is added by the sensitivity of the triggers to opening stocks and world price.

[37] Policy D was also run using 80,000 rather than 100,000 tons in the computation of the trigger adjustment. The result was inferior to the one presented.

[38] The standard deviation of price that results from simulating the net purchases equation estimated above is $13.00. In order to lower the price variability to $21.10, an equation was estimated for an optimal policy with a lower price variability, and the coefficients were interpolated to yield the net purchases equation used for policy E. The interpolated equation is

$$NP_t = -1{,}855 + 0.49 \cdot WP_t + 0.80 \cdot Q_t - 0.091 \cdot S_t - 1.$$

price band policy. Despite the very high R^2 of the net purchases equation, the standard error of the estimate (16,000 tons) is large enough to cause the policy to be quite inefficient.

Figures 11 through 13 suggest that a more appropriate way to model the optimal net purchases function would be to use three linear segments: first, for production greater than or equal to normal; second, for production less than normal but with the shortfall less than the opening stock level; and third, for production plus opening stocks less than normal production. The following regressions, estimated from the standard optimal policy with price weight of 17 and import weight of 60, indicate that this is a fruitful way to proceed:

$$Q_t \geqslant 2250, \tag{27}$$

$$\begin{array}{llll} NP_t = \underset{(7.4)}{-1{,}937.3} + \underset{(0.0150)}{0.6121} \cdot WP_t & + \underset{(0.0030)}{0.8219} \cdot Q_t & - \underset{(0.0028)}{0.05317} \cdot S_{t-1}; \end{array}$$

$N = 750, \ R^2 = 0.994, \ SEE = 9.44.$

$$Q_t < 2250 \text{ and } Q_t + S_{t-1} \geqslant 2250, \tag{28}$$

$$\begin{array}{llll} NP_t = \underset{(16.3)}{-1{,}916.7} + \underset{(0.0194)}{0.5098} \cdot WP_t & + \underset{(0.0074)}{0.8201} \cdot Q_t & - \underset{(0.0047)}{0.07441} \cdot S_{t-1}; \end{array}$$

$N = 280, \ R^2 = 0.990, \ SEE = 7.25.$

$$Q_t + S_{t-1} < 2250, \tag{29}$$

$$\begin{array}{llll} NP_t = \underset{(17.8)}{-1{,}925.6} + \underset{(0.0345)}{0.3207} \cdot WP_t & + \underset{(0.0084)}{0.8550} \cdot Q_t & - \underset{(0.0118)}{0.08770} \cdot S_{t-1}; \end{array}$$

$N = 320, \ R^2 = 0.989, \ SEE = 12.92.$

Standard errors are in parentheses.

All of the coefficients are significantly different from the corresponding coefficients in the other two equations except the coefficients of production in equations (27) and (28). More important for the purposes at hand, all of the standard errors are considerably less than the standard error of 15.98 for the original equation (25). The standard error of 7.25 for equation (28) is about as small as could be expected when the original data are constrained to multiples of 20.

The results of simulating a policy with net purchases defined by a piecewise linear function are exceptionally close to the optimal policy, as shown in Table 15 and Figure 15.[39] The primary difference between policy D and the optimal policy is on the export

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[39] As in the case of the linear net purchases equation, the standard deviation of price is higher than \$12.10 when the equations given in the text are simulated. Consequently, the same equations were estimated for an optimal policy with a lower level of price variability and the coefficients interpolated to yield the following three equations, which produce the results in Table 15:

$$\begin{array}{ll} Q_t > 2{,}250: & -1{,}954.7 + 0.5796 \cdot WP_t + 0.8317 \cdot Q_t - 0.0506 \cdot S_t - 1, \\ 2{,}250 - S_t - 1 < Q_t < 2{,}250: & -1{,}932.0 + 0.4844 \cdot WP_t + 0.8287 \cdot Q_t - 0.0714 \cdot S_t - 1, \\ Q_t < 2{,}250 - S_t - 1: & -1{,}940.3 + 0.3095 \cdot WP_t + 0.8618 \cdot Q_t - 0.0824 \cdot S_t - 1. \end{array}$$

side. This is most likely the result of always exporting 100,000 of the first 200,000 tons of available supply; Figures 13 and 14 indicate that the slope and placement of that first segment are somewhat sensitive to world price, as would be anticipated. Nevertheless, the modeled policy is very close. Since the standard deviation of cost is almost $3 million, policy F would be indistinguishable from the optimal policy in practice.

Summary of Major Results

The price band schemes generally underestimate the cost of decreasing price variability, since these schemes become relatively more efficient with decreasing price variability.

The cost of decreasing annual average imports by 1,000 tons ranges from $27,000 to almost $170,000 annually; the cost increases with decreases in price variability and average imports. The higher the weight on price variability, the less flexibility is allowed the optimizing algorithm in adjusting consumption to match production. Thus as price variability declines, the optimal policies are forced to hold more stocks in order to decrease imports, rather than allowing consumption to fall when production is low. This leads to a higher trade-off between imports and cost.

The cost of decreasing the standard deviation of price by $1.00 per ton ranges from $330,000 to $630,000 annually. This cost also increases with decreases in price variability and average imports.

It is possible to make up about 60 percent of the difference between the price band and optimal policies while retaining the maximum and minimum triggers of a price band scheme. The larger share of the remaining difference can be made up by making net purchases a piecewise linear function of production, world price, and opening stocks.

7

CONCLUSIONS AND POLICY IMPLICATIONS

At this point, the trade-offs between different government objectives have been measured, and the optimal policies have been compared and contrasted with the price band policies. The previous chapters show that there is considerable room for improvement upon the simple price band policies considered earlier by the Inter-Ministerial Working Group and that a relatively simple policy is virtually as efficient as the optimal policy. This chapter examines the implications, first, for policy analysis in general, and second, for policymakers in Kenya.

Implications for Policy Analysis

Four benefits of optimization are outlined in Chapter 3: the screening of many policy alternatives, the accurate measurement of trade-offs between objectives, the measurement of the degree of suboptimality of alternative policies, and the opportunity to learn from the optimal policy. The major methodological question addressed by this study is whether or not these benefits of optimization outweigh the considerable costs of the optimization process. Given the nature of the results, the answer is undoubtedly yes. The major objective of the study was to measure trade-offs; as shown in Chapter 6, the simulated price band policies do not measure accurately the trade-off between cost and price stability, or between cost and imports. So for that reason alone, the optimization process has been necessary and worthwhile.

The gains from optimization were not limited to the measurement of trade-offs, however. The optimization process screened out the infinitely many possible shapes of the net purchases function and suggested its formulation as a piecewise linear curve with three segments. The degree of suboptimality of the price band policies was seen to be large, and therefore these policies were modified based on insights provided by the optimal policy. Since policy F—the policy with a piecewise net purchases function, flexible maximum stock level, and exports of 100,000 tons of the first 200,000 tons of available supply—was only slightly suboptimal, no further modifications were made. Without having the goal of the optimal trade-off curve in mind, there would have been no way of knowing whether or not policies that are far superior to policy F exist.

The optimal policies themselves challenge some of the common assumptions about maize policy in Kenya. For example, most economists, including the author of this study, thought that carry-out stocks in 1982 and 1983 were too high and the government should have exported in those years. If the minimum stock level kept on hand as a cushion for the arrangement of imports is considered to be 300,000 tons, then carry-out (used in the sense of this study, total stock minus the import cushion) during 1982 and 1983 was about 350,000 tons. The model shows that these amounts were not excessive given some reasonable combinations of objective function weights and 1982/83 world prices and production levels, particularly with the 12 percent production variability assumption.

Thus optimization yields many insights into the problem and possible solutions, and was undoubtedly a profitable way to proceed given the objectives and constraints of the study. But this analysis was conducted in a research environment. The situation of a Third World government economist who needs to complete a report within a month if it is to affect the decisionmaking process is quite different; optimization may be impossible in such circumstances. The following lessons are proposed.

If the structure of the model used here is fairly similar to the structure of the market in the country of interest, it would be possible to accept a policy like policy F as a proxy for an optimal policy and simulate that policy across a large number of different parameters to approximate an optimal outcome. Trade-offs could be measured by this curve, and other policies compared to it for sub-"optimality".

On the other hand, there could be circumstances in which the basic structure of the policy has already been decided. In such circumstances, optimization may not be necessary. For example, if the price band policy studied by the Inter-Ministerial Working Group had been accepted as a strategy, the trade-offs measured by the price band curves would have been the relevant numbers for the government. Because there are only two parameters to vary with these policies, it is quite easy to find the best policy of this type without optimization. More complex policies that require several parameters for a complete definition will be less amenable to finding the best choice through simulation. For sufficiently complex policies, some optimization, perhaps of a subset of the problem, may be necessary.

Optimization was useful to this study even though the specific policies that were produced by the optimization process are not recommended. This point has been made elsewhere: "Formal and simplified optimization can provide a number of useful starting points for a process of policy design and dialogue. In no sense does it guarantee an optimal or even adequate policy" (Clark, Jones, and Holling 1979, 32). Utility functions of decisionmakers are always more complex than those that become the objective functions of optimization models; in addition, the process of reforming public policy always involves a set of compromises among officials with different utility functions. No optimization model can possibly deal completely with such complex situations. Nevertheless, as an aid to policy design, as a screening method across policy alternatives, as a reference point for other policies, and as a measuring device for trade-offs, the dynamic programming analysis has been invaluable.

Implications for Policy

For Kenyan decisionmakers, the key results that come out of this study are the high savings associated with increased price flexibility. At the lowest end of price stability measured here, each dollar increase in the standard deviation of price saves $400,000-$600,000 annually. This implies that a policy that has a standard deviation of price of 5 percent of the target price would be at least $3.5 million and probably closer to $6 million less in annual average cost than a policy that succeeded in holding prices constant.[40] These figures represent between one-tenth and one-fifth of the annual development budget of Kenya's Ministry of Agriculture. Given these high costs, it is not surprising that the NCPB has failed to implement the stated policy of keeping prices constant.

As demonstrated in Chapter 2, under present policies there is de facto price flexibility. This is the result of the large costs associated with implementing the stated policy of constant prices. If this existing price instability were acknowledged and built into the system, the price instability could be spread out over a larger population, causing less stress on any one group. In addition, an explicit decision could be made by senior officials about the trade-off between cost and price stability rather than forcing parastatal officials to make the decision based on their own fiscal constraints.

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[40] Since the cost per unit decrease in price variability would continue to increase as price variability decreased, the numbers given in the text for average annual cost are slightly higher than the trade-offs found in the table.

Both policy D and policy F described in Chapter 6 appear to be large improvements over the present policy and the type of price band schemes previously analyzed. The main elements of these policies are flexibility to world price, opening stocks, and production. Both policies make closing stocks sensitive to world price, and allow some exports if a white maize premium is available. In addition, both policies allow domestic net purchases—and thus the domestic price—to vary with the world price and opening stocks of the marketing board. The main difference between the two policies is that policy F allows the domestic price to vary somewhat with domestic production.[41]

This final adjustment saves a large amount of money, but would require more radical adjustments to present policy. Questions about implementation of these types of policies are addressed in the following section.

Considerations for Implementation

Implementation issues will be considered, first, for the foreign trade/domestic stock rules, which are the same for policies D and F; second, for a domestic price policy that is flexible with respect to opening stocks and world prices; and finally, for a domestic price policy that adjusts for unanticipated changes in domestic production.

Foreign Trade and Domestic Storage Policy

The export rules considered above—varying the maximum stock level inversely with the world price, and exporting one-half of the reserve stock if significant white maize premiums are available—would be easy to implement. The results in Chapter 5 clearly show that this type of export rule dominates rules in which exports are triggered by stocks alone. Since the policy can be set up so that on average the same amount of maize is imported as under any particular storage trigger policy, this aspect of the policy modification can be made invisible on average to consumers and producers.

The maximum stock level, however, should also be dependent on the government's relative preferences for low imports, low price variability, and low fiscal costs. If the government's desire to minimize imports were to decline, the correct maximum stock level would decline also. The relationship between maximum stock level and world price that was estimated in Chapter 6 was appropriate for a policy that allows price to vary plus or minus about 9 percent from the target price (price variability of $12.10) and that yields average imports of about 45,000 tons. A somewhat different relationship would hold with smaller or larger price bands, or with a different preference for imports. These different relationships could be estimated from the appropriate optimal policy.

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[41] The implied elasticity of domestic price for domestic production in policy F is about -0.6, implying that a 20 percent shortfall in production would lead to a 12 percent increase in the official price. This elasticity, however, is a function of the government's assumed preference for price stability. The elasticity would be lower if the preference for price stability were assumed to be higher.

Price Policy Responsive to Opening Stocks and World Price

At present, official producer prices for the harvest are announced before planting time, and official consumer prices are announced for the next 12 months about 1 month before the first maize is harvested. Clearly, any move toward flexible official prices would change this procedure considerably.

The type of modifications discussed here, however, could be implemented with relatively minor modifications to the present policy. It is shown in Chapter 5 that the degree to which domestic prices respond to world price and opening stocks in policy D is not large. Thus it would be possible to announce a floor price at planting time based on an optimistic prediction about end-year stocks and a pessimistic prediction of the world price at harvest time. These predictions should be sufficiently optimistic/pessimistic so that it is unlikely that actual stocks and world prices would be respectively higher or lower than the predicted value. Thus the announced floor price would be the lowest possible optimal domestic price.

At the time of announcement, the public could be informed that the government buying price is expected to be higher than the floor price. The government might find it in its interest to announce an expected price or a maximum price or both simultaneously with the floor price. The announcement could include indications of how sensitive the price would be to changes in the world price and government stocks. The expected buying price—based on the expected values of the two key variables—could be published in the local press regularly. A similar procedure could be followed for the government selling price.

Before the buying season begins, the government would make a final announcement; all maize bought during that marketing year would be at the set price. During the year, farmers would have the option of selling to the NCPB at the floor price or selling to traders; millers would have the option of buying from the board at the government selling price or buying directly from farmers or traders.

For the farmer the most significant change resulting from such a policy would be the possibility of adjustments in official prices after the crop has been planted. But given the fairly small sensitivity of domestic price to world price and opening stocks measured in the previous chapters, the required adjustments would not be large. There would have to be large, unanticipated movements in world prices and domestic stocks for the required price change to be as large as 10 percent. The possibility of such a price change is much less than many farmers experience under the present system with the possibility of waiting many months to receive payment, or not being able to sell to the board at all.

For the urban consumer, the presence of a price band would imply that there would be some change in price during the year, with lower prices at harvest time and higher prices before harvest in most years.[42] The extent of these changes would be determined by the width of the price band.

Price Policy Responsive to Domestic Production

The domestic price could be made sensitive to domestic production in a similar fashion. Theoretically, the policy adjustment is simple: before planting time, calculate the floor price after taking into account an optimistic estimate of production. The final price would be determined by the actual production level.

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[42] The price rise would result not from changes in official prices, but from storage costs incurred by the private sector. Such price rises would occur only in years during which the price is between the NCPB floor and ceiling during some months. There would be no seasonal price rise during a poor crop year in which the NCPB's ceiling price was effective at harvest time and remained effective throughout the year.

Production estimates, however, are subjective, unreliable (as discussed in Chapter 4), and unavailable until after most of the crop has been purchased. In addition, the buying season in Kenya is spread out over about six months, with purchases in the west beginning long before the large purchases from the Rift Valley. A price policy that depends on subjective estimates of production several months before the major harvest would be subject to large errors. Given these problems, implementation of a policy such as this one probably could be done most efficiently by a series of tender offers.[43]

A tender procedure for implementing such a policy might look like the following. Suppose it is August. The harvest is beginning in the west, and total annual production is predicted to be about 200,000 tons above trend. Given this production estimate and the present stock level and world price, suppose that the chosen strategy calls for a price of $125 per ton and net purchases of 100,000 tons for the year. The NCPB could advertise a tender offer to buy, say, a total of 10,000 tons for delivery in September in appropriately sized lots, and ask for bids. The bidding process would give the board additional feedback on prices and production, and this information would be used when deciding how much to offer to buy in October. Similar offers could be made in each of the months of the buying season.

Such a procedure may be workable, but the mechanism would be considerably more complicated and management-intensive than setting floor and ceiling prices. The cost savings that result from making the domestic price sensitive to production are about $600,000 in average annual cost. Whether or not the benefits of cost savings outweigh the increased complexity of implementation and administration is a political judgment.

Conclusions

This study has measured trade-offs between government objectives and has given indications of how the efficient policies that result from the model might be implemented. The three major trade-offs are between cost and price stability, between cost and imports, and between cost and complexity. The next step in policy reform is political; deciding how important each of the goals—price stability, low imports, low fiscal cost, low complexity of policy—is relative to the others.

A general strategy for pricing, stockholding, and foreign trading would be determined through the political choice of a strategy that yields a feasible combination of the objectives. Before the strategy is implemented, however, it would be desirable to study the tactical decisions of how the policy would be implemented within the seasonal and regional framework of the real world. For deciding on the broad approach the country wishes to pursue, a model that includes regions of the country and seasons of the year would have obscured rather than clarified the issues. For choosing the exact specification of the policy once a broad approach has been decided upon, however, a quarterly or monthly management model that includes four or five regions could be quite helpful. The purpose of the management model would be to determine the best way to achieve the annual values of the variables recommended by the accepted strategy. Thus, the model would only need to be 12 or 18 months long. Although the paucity of data would mean that heroic assumptions would have to be made about some of the parameters, considerable insight could be gained into the best methods for implementing the chosen policy in the real world.

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[43] An alternative might be to base the decision on an objective measure, such as rainfall at particular stations.

The study, then, has outlined the economic costs and benefits of some major choices available to the Kenyan government and has sketched the analytical steps that follow from acceptance of a specific strategy. Much can be gained in terms of lower cost and lower imports by allowing prices to reflect domestic production, world price, and domestic stock levels. The types of policies outlined here would be considerably more efficient at increasing price flexibility than the simple price band/buffer stock policy that was simulated by the Inter-Ministerial Working Group.

APPENDIX 1: SUPPLEMENTARY TABLES

Table 16—Price band results for demand elasticity equal −0.2

							Components of Fiscal Cost			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Price Band	Stock Variability	Standard Deviation of Price	Imports	Average Annual Fiscal Cost	Standard Deviation of Cost	Average Stock Level	Replace Stock Charges	Storage Costs	Domestic Trading Losses	Foreign Trading Losses
(percent)	(1,000 metric tons)	(US$/ metric ton)	(1,000 metric tons)	(US$ million)		(1,000 metric tons)	(US$ million)			
4.75	0	6.5	72.5	3.41	3.35	0	0.86	0.00	−0.08	2.62
4.75	100	6.5	54.5	3.90	3.49	51	0.43	1.36	−0.08	2.21
4.75	200	6.5	43.6	4.60	3.78	103	−0.03	2.59	−0.08	2.12
4.75	300	6.5	37.1	5.47	4.24	153	−0.47	3.71	−0.08	2.29
4.75	400	6.5	33.1	6.28	4.76	201	−0.88	4.67	−0.08	2.58
6.75	0	9.1	68.7	2.65	3.25	0	0.86	0.00	−0.48	2.26
6.75	100	9.1	51.4	3.23	3.39	51	0.43	1.37	−0.48	1.92
6.75	200	9.1	41.0	3.98	3.71	103	−0.03	2.59	−0.48	1.89
6.75	300	9.1	34.9	4.87	4.18	153	−0.45	3.71	−0.48	2.09
6.75	400	9.1	31.2	5.70	4.72	200	−0.86	4.63	−0.48	2.41
9.20	0	12.2	64.3	1.78	3.13	0	0.86	0.00	−0.92	1.84
9.20	100	12.2	47.7	2.47	3.30	51	0.43	1.38	−0.92	1.60
9.20	200	12.2	38.0	3.27	3.65	103	−0.03	2.59	−0.92	1.62
9.20	300	12.2	32.3	4.18	4.14	152	−0.45	3.69	−0.92	1.86
9.20	400	12.2	29.0	5.00	4.68	199	−0.86	4.58	−0.92	2.21
13.10	0	17.0	57.8	0.57	2.94	0	0.86	0.00	−1.54	1.25
13.10	100	17.0	42.3	1.44	3.17	51	0.43	1.40	−1.54	1.16
13.10	200	17.0	33.7	2.30	3.55	102	−0.01	2.59	−1.54	1.26
13.10	300	17.0	28.7	3.21	4.09	151	−0.44	3.63	−1.54	1.57
13.10	400	17.0	25.9	4.02	4.66	197	−0.84	4.47	−1.54	1.93

Table 17—Price band results for production variability equal 12 percent

							Components of Fiscal Cost			
(1) Price Band	(2) Stock Variability	(3) Standard Deviation of Price	(4) Imports	(5) Average Annual Fiscal Cost	(6) Standard Deviation of Cost	(7) Average Stock Level	(8) Replace Stock Charges	(9) Storage Costs	(10) Domestic Trading Losses	(11) Foreign Trading Losses
(percent)	(1,000 metric tons)	(US$/ metric ton)	(1,000 metric tons)	(US$ million)		(1,000 metric tons)	(US$ million)			
5.10	0	6.9	84.0	3.71	4.05	0	0.86	0.00	−0.23	3.06
5.10	100	6.9	66.0	4.23	4.16	51	0.43	1.36	−0.23	2.67
5.10	200	6.9	54.3	4.91	4.46	103	−0.03	2.58	−0.23	2.57
5.10	300	6.9	46.7	5.72	4.86	153	−0.47	3.74	−0.23	2.67
5.10	400	6.9	41.8	6.56	5.36	202	−0.89	4.75	−0.23	2.93
5.10	450	6.9	40.1	6.95	5.62	226	−1.09	5.19	−0.23	3.07
5.10	500	6.9	38.8	7.33	5.88	249	−1.29	5.60	−0.23	3.25
6.80	0	9.1	79.5	2.86	3.90	0	0.86	0.00	−0.67	2.65
6.80	100	9.1	62.1	3.47	4.06	51	0.43	1.36	−0.67	2.36
6.80	200	9.1	51.0	4.20	4.36	103	−0.03	2.58	−0.67	2.30
6.80	300	9.1	44.0	5.04	4.79	152	−0.45	3.71	−0.67	2.45
6.80	400	9.1	39.5	5.87	5.30	201	−0.88	4.70	−0.67	2.73
9.55	0	12.5	72.4	1.62	3.71	0	0.86	0.00	−1.24	2.00
9.55	100	12.5	56.1	2.41	3.90	51	0.43	1.37	−1.24	1.84
9.55	200	12.5	46.0	3.19	4.24	102	−0.03	2.58	−1.24	1.36
9.55	300	12.5	39.7	4.07	4.70	151	−0.45	3.69	−1.24	2.08
9.55	400	12.5	35.7	4.90	5.23	199	−0.86	4.60	−1.24	2.38
12.82	0	16.4	64.7	0.36	3.50	0	0.86	0.00	−1.80	1.28
12.82	100	16.4	49.6	1.30	3.75	51	0.43	1.40	−1.80	1.28
12.82	200	16.4	40.6	2.17	4.14	101	−0.01	2.57	−1.80	1.40
12.82	300	16.4	35.1	3.09	4.64	150	−0.44	3.63	−1.80	1.68
12.82	400	16.4	31.7	3.90	5.19	196	−0.84	4.51	−1.80	2.02

Table 18—Optimal policy results for demand elasticity equal −0.2

							Components of Fiscal Cost			
(1) Price Stability Weight	(2) Import Weight	(3) Standard Deviation of Price	(4) Imports	(5) Average Annual Fiscal Cost	(6) Standard Deviation of Cost	(7) Average Stock Level	(8) Replace Stock Charges	(9) Storage Costs	(10) Domestic Trading Losses	(11) Foreign Trading Losses
		(US$/ metric ton)	(1,000 metric tons)	(US$ million)		(1,000 metric tons)	(US$ million)			
33.0	92	6.5	49.6	3.14	3.58	94	0.05	2.20	−0.32	1.21
35.9	138	6.5	43.5	3.73	3.90	121	−0.18	2.89	−0.03	1.05
39.4	184	6.5	39.1	4.28	4.15	146	−0.40	3.42	0.18	1.08
43.1	230	6.5	36.0	4.78	4.36	170	−0.60	3.85	0.40	1.13
47.2	276	6.5	33.6	5.31	4.68	188	−0.76	4.29	0.55	1.23
21.7	69	9.1	50.5	2.07	3.21	74	0.23	1.74	−0.86	0.96
22.8	115	9.1	43.7	2.57	3.54	103	−0.03	2.45	−0.61	0.76
24.9	161	9.1	38.2	3.21	3.89	129	−0.25	3.10	−0.36	0.72
27.1	207	9.1	35.7	3.59	4.12	146	−0.40	3.43	−0.12	0.68
29.3	253	9.1	32.6	4.14	4.34	170	−0.61	3.89	0.20	0.67
14.1	46	12.2	52.7	0.84	2.79	52	0.42	1.28	−1.77	0.91
15.6	92	12.2	45.4	1.24	3.14	78	0.19	1.86	−1.28	0.45
16.9	138	12.2	39.0	1.80	3.47	104	−0.04	2.48	−0.84	0.19
18.2	184	12.2	34.3	2.41	3.82	129	−0.25	3.08	−0.56	0.15
19.6	230	12.2	31.1	2.95	4.07	149	−0.43	3.50	−0.25	0.13
8.8	33	17.0	51.4	−0.64	2.41	39	0.53	0.96	−2.94	0.81
9.8	79	17.0	42.8	−0.24	2.82	61	0.33	1.51	−2.08	−0.02
10.7	126	17.0	36.9	0.25	3.11	86	0.12	2.06	−1.58	−0.35
11.8	172	17.0	31.8	0.86	3.46	110	−0.08	2.61	−1.07	−0.58
12.6	219	17.0	28.6	1.37	3.76	128	−0.24	3.04	−0.77	−0.65

Table 19—Optimal policy results for production instability equal 12 percent

							Components of Fiscal Cost			
(1) Price Stability Weight	(2) Import Weight	(3) Standard Deviation of Price	(4) Imports	(5) Average Annual Fiscal Cost	(6) Standard Deviation of Cost	(7) Average Stock Level	(8) Replace Stock Charges	(9) Storage Costs	(10) Domestic Trading Losses	(11) Foreign Trading Losses
		(US$/ metric ton)	(1,000 metric tons)	(US$ million)		(1,000 metric tons)	(US$ million)			
42.5	99	6.9	57.3	3.34	4.26	106	−0.05	2.46	−0.31	1.24
47.2	146	6.9	51.0	3.90	4.62	133	−0.29	3.10	0.05	1.04
52.3	193	6.9	45.8	4.54	4.94	158	−0.50	3.70	0.41	0.93
56.9	240	6.9	42.5	5.04	5.19	180	−0.69	4.14	0.73	0.88
62.0	287	6.9	39.5	5.68	5.42	200	−0.86	4.62	1.00	0.93
30.2	92	9.1	56.0	2.24	4.01	92	0.07	2.18	−0.74	0.73
33.2	138	9.1	48.8	2.87	4.35	123	−0.20	2.87	−0.32	0.51
36.5	184	9.1	43.6	3.49	4.68	145	−0.40	3.43	0.07	0.37
40.0	230	9.1	40.3	4.01	4.98	164	−0.55	3.85	0.49	0.23
43.6	276	9.1	37.3	4.52	5.23	182	−0.71	4.26	0.80	0.17
18.9	69	12.5	55.2	0.63	3.47	72	0.24	1.72	−1.93	0.59
21.4	115	12.5	48.5	1.10	3.83	92	0.07	2.22	−1.20	0.00
23.9	161	12.5	42.6	1.71	4.21	119	0.07	2.77	−0.48	−0.41
25.8	207	12.5	38.2	2.28	4.54	139	−0.34	3.27	−0.02	−0.62
28.2	253	12.5	34.8	2.82	4.84	156	−0.48	3.67	0.42	−0.80
12.0	40	16.4	56.8	−1.09	2.82	45	0.48	1.13	−3.37	0.67
13.4	80	16.4	49.5	−0.77	3.23	63	0.32	1.53	−2.44	−0.19
15.1	120	16.4	43.7	−0.37	3.62	80	0.17	1.94	−1.60	−0.87
16.5	160	16.4	38.9	0.16	3.91	100	0.00	2.37	−0.96	−1.25
17.8	200	16.4	34.4	0.71	4.17	116	−0.14	2.80	−0.51	−1.43

Table 20—Price band results for comparison with optimal

							Components of Fiscal Cost			
(1) Price Band	(2) Stock Variability	(3) Standard Deviation of Price	(4) Imports	(5) Average Annual Fiscal Cost	(6) Standard Deviation of Cost	(7) Average Stock Level	(8) Replace Stock Charges	(9) Storage Costs	(10) Domestic Trading Losses	(11) Foreign Trading Losses
(percent)	(1,000 metric tons)	(US$/ metric ton)	(1,000 metric tons)	(US$ million)		(1,000 metric tons)	(US$ million)			
4.88	0	6.6	67.9	2.94	3.24	0	0.87	0.00	−0.15	2.22
4.88	25	6.6	62.9	3.04	3.24	13	0.76	0.34	−0.15	2.09
4.88	50	6.6	58.4	3.17	3.27	26	0.65	0.68	−0.15	2.00
4.88	75	6.6	54.3	3.34	3.31	38	0.53	1.03	−0.15	1.94
4.88	100	6.6	50.7	3.54	3.38	51	0.42	1.37	−0.15	1.90
4.88	150	6.6	44.9	3.89	3.51	77	0.20	1.99	−0.15	1.86
4.88	200	6.6	40.5	4.30	3.70	103	−0.02	2.59	−0.15	1.88
4.88	250	6.6	37.1	4.73	3.92	127	−0.24	3.16	−0.15	1.96
4.88	300	6.6	34.5	5.18	4.17	152	−0.45	3.69	−0.15	2.09
4.88	350	6.6	32.5	5.60	4.43	176	−0.66	4.17	−0.15	2.24
4.88	400	6.6	30.9	6.00	4.71	199	−0.86	4.60	−0.15	2.41
6.80	0	9.0	62.7	2.09	3.09	0	0.87	0.00	−0.51	1.73
6.80	25	9.0	57.9	2.23	3.10	13	0.76	0.34	−0.51	1.63
6.80	50	9.0	53.6	2.40	3.13	26	0.65	0.69	−0.51	1.57
6.80	75	9.0	49.8	2.60	3.19	38	0.54	1.04	−0.51	1.54
6.80	100	9.0	46.4	2.83	3.26	51	0.42	1.38	−0.51	1.53
6.80	150	9.0	41.1	3.21	3.41	77	0.20	1.99	−0.51	1.52
6.80	200	9.0	37.0	3.64	3.61	102	−0.02	2.59	−0.51	1.58
6.80	250	9.0	33.9	4.09	3.85	127	−0.23	3.15	−0.51	1.68
6.80	300	9.0	31.5	4.54	4.11	151	−0.44	3.66	−0.51	1.83
6.80	350	9.0	29.7	4.95	4.38	175	−0.65	4.12	−0.51	1.99
6.80	400	9.0	28.4	5.35	4.66	198	−0.85	4.54	−0.51	2.18
9.37	0	12.1	56.3	1.10	2.90	0	0.87	0.00	−0.92	1.14
9.37	25	12.1	51.8	1.28	2.93	13	0.76	0.35	−0.92	1.08
9.37	50	12.1	47.8	1.50	2.97	25	0.65	0.70	−0.92	1.06
9.37	75	12.1	44.3	1.74	3.04	38	0.54	1.05	−0.92	1.07
9.37	100	12.1	44.1	2.00	3.12	51	0.42	1.40	−0.92	1.09
9.37	150	12.1	36.4	2.41	3.29	77	0.20	2.00	−0.92	1.13
9.37	200	12.1	32.8	2.87	3.52	101	−0.01	2.58	−0.92	1.22
9.37	250	12.1	30.0	3.35	3.77	126	−0.23	3.13	−0.92	1.36
9.37	300	12.1	27.9	3.79	4.04	150	−0.43	3.61	−0.92	1.53
9.37	350	12.1	26.4	4.20	4.33	173	−0.63	4.04	−0.92	1.71
9.37	400	12.1	25.3	4.58	4.63	196	−0.83	4.44	−0.92	1.90
13.10	0	16.4	48.0	−0.10	2.67	0	0.87	0.00	−1.38	0.42
13.10	25	16.4	44.0	0.14	2.71	13	0.76	0.36	−1.38	0.41
13.10	50	16.4	40.4	0.42	2.78	26	0.65	0.71	−1.38	0.44
13.10	75	16.4	37.2	0.71	2.87	38	0.53	1.07	−1.38	0.49
13.10	100	16.4	34.4	1.02	2.97	51	0.42	1.42	−1.38	0.56
13.10	150	16.4	30.4	1.49	3.18	76	0.21	2.01	−1.38	0.65
13.10	200	16.4	27.4	1.99	3.43	100	−0.00	2.58	−1.38	0.80
13.10	250	16.4	25.1	2.46	3.71	124	−0.21	3.08	−1.38	0.98
13.10	300	16.4	23.5	2.90	4.00	147	−0.41	3.53	−1.38	1.16
13.10	350	16.4	22.3	3.30	4.29	170	−0.61	3.93	−1.38	1.36
13.10	400	16.4	21.6	3.65	4.60	191	−0.79	4.27	−1.38	1.56

Table 21—Trade-offs with price elasticity equal −0.2

	Standard Deviation of Price			
Trade-off	17.0	12.2	9.1	6.5
	(US$1,000/year)			
Cost per 1,000-metric-ton decrease in average annual imports				
As imports decline from 44,000 to 34,000 metric tons				
Price bands	93	100	130	152
Optimal policies	90	110	134	153
Cost per US$ decrease in standard deviation of price				
When average annual imports equal 44,000 metric tons				
Price bands	...	299	317	314
Optimal policies	...	345	385	435
When average annual imports equal 34,000 metric tons				
Price bands	...	341	375	395
Optimal policies	...	387	463	506

Table 22—Trade-offs with production variability equal 12 percent

	Standard Deviation of Price			
Trade-off	16.4	12.5	9.1	6.9
	(US$1,000/year)			
Cost per 1,000-metric-ton decrease in average annual imports				
As imports decline from 50,000 to 40,000 metric tons				
Price bands	98	116	146	161
Optimal policies	84	105	129	142
Cost per US$ decrease in standard deviation of price				
When average annual imports equal 50,000 metric tons				
Price bands	...	409	424	478
Optimal policies	...	459	522	571
When average annual imports equal 40,000 metric tons				
Price bands	...	451	515	544
Optimal policies	...	514	593	687

APPENDIX 2: PSEUDOCODES FOR PRICE BAND AND OPTIMIZATION PROGRAMS

Pseudocode for price band simulation program

```
Compute $Q_{max}$ and $Q_{min}$
Loop for number of cycles
t = 0, $S_0 = 100$
Loop for number of years in cycle
    Random selection of $WP_t$ and $Q_t$
    If $Q_t < Q_{min}$ then
        $NP_t = Q_t - Q_{min}$
    Else
        If $Q_t > Q_{max}$ then
            $NP_t = Q_t - Q_{max}$
        Else
            $NP_t = 0$
        Endif
    Endif
    $S_t = S_{t-1} + NP_t$
    If $S_t < 0$ then
        $M_t = -S_t$
        $S_t = 0$
    Else
        If $S_t > S_{max}$ then
            $X_t = S_t - S_{max}$
            $S_t = 0$
        Else
            $X_t = 0$
            $M_t = 0$
        Endif
    Endif
    Compute all costs
    If t = 10 then
        Add replace stock charges
        Add all costs to summary variables
    Endif
Next year in cycle
Next cycle
Produce printout
```

Pseudocode for optimization program

```
*First section computes cost-to-go in final year
Loop for each possible state of the world (WP, Q, S)
$GC_{min}$ = a very large number
Loop for each possible combination of control variables (NP, X, M)
    If this is realistic control combination for this state, then
        Compute GC for this state and control
        If $GC < GC_{min}$ then
            $GC_{min} = GC$
        Endif
    Endif
Next control
Next state
*Next section does the backward recursion
Loop for each year, beginning with final year
Compute $E(GC_{t+1} \mid S_t)$; that is, the expected costs in future years of carrying out
    $S_t$ in the present year

    This equals the sum of $GC_{min}$ for each particular stock level, the $GC_{min}$'s being
    weighted by the probability of that production level and world price occurring.

Loop for each possible state of the world
    $GC_{min}$ = a very large number
    Loop for each possible combination of control variables
        If this is a realistic control for this state, then
            Compute GC for this state and control
            If $GC + E(GC_{t+1} \mid S_t) < GC_{min}$ then
                $GC_{min} = GC + E(GC_{t+1} \mid S_t)$
            Endif
        Endif
    Next control
Next state
Next year
*Next section does simulation of optimal policy
Loop for number of cycles
$t = 0, S_0 = 100$
Loop for number of years in cycle
    Random selection of $WP_t$ and $Q_t$
    Interpolation of optimal policy to compute proper values of
        $NP_t$, $X_t$, and $M_t$ given $WP_t$, $Q_t$, and $S_{t-1}$
    Compute all costs
    If t = 10 then
        Add replace stock charges
        Add all costs to summary variables
    Endif
Next year in cycle
Next cycle
Produce printout
```

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